

# **INTERNATIONAL PACIFIC HALIBUT COMMISSION**

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

## **ANNUAL REPORT 1972**

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**SEATTLE, WASHINGTON**

**1973**

This Annual Report is for the Commission's 49th year. Two other series, Scientific Reports and Technical Reports, present the results of scientific studies and statistical records of the fishery. Information Bulletins that summarize research results are distributed to fishermen and industry members.

INTERNATIONAL PACIFIC HALIBUT COMMISSION

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# Preface

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The International Pacific Halibut Commission was established in 1923 by a Convention between Canada and the United States for the preservation of the halibut fishery of the North Pacific Ocean and the Bering Sea. The Convention was the first international agreement providing for joint management of a marine fishery. The Conventions of 1930, 1937 and 1953 extended the Commission's authority and specified that the halibut stocks be developed and maintained at levels to permit the maximum sustained yield.

Three Commissioners are appointed by the Governor General of Canada and three by the President of the United States. The Commissioners appoint the Director of Investigations who supervises the scientific and administrative staff. The scientific staff collects and analyzes statistical and biological data needed to manage the halibut fishery. The headquarters and laboratory are located at the University of Washington in Seattle, Washington. Each country provides one-half of the Commission's annual appropriation.

The Commissioners meet annually to review the regulatory proposals made by the scientific staff and consider advice of the Conference Board, representing vessel owners and fishermen, and of other interested parties. The regulatory measures are submitted to the two governments, and the fishermen of both nations are required to observe those regulations that are adopted.

INTERNATIONAL PACIFIC HALIBUT COMMISSION  
ANNUAL REPORT 1972

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# Activities of the Commission

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The Commission held its 48th Annual Meeting in Seattle, Washington, January 20-25, 1972. Dr. William M. Sprules presided as Chairman and Mr. Neils M. Evens was Vice Chairman. At the public session, the staff reviewed the results of scientific investigations, the effects of the 1971 halibut regulations and the condition of the halibut stocks. The session was attended by representatives of the Pacific Coast halibut industry and other interested persons. The Commission also met with the Conference Board whose members represent vessel owners and fishermen. A hearing was held with representatives of the International Trawlers Association. The recommendations of these organizations were thoroughly considered by the Commission. The work by the scientific staff on incidental catch of halibut by trawls was reviewed and the Commission concluded that to achieve the maximum sustained yield, halibut taken in the trawl fishery should not be retained.

Regulatory proposals were adopted for the 1972 halibut season and submitted to the Canadian and United States Governments for approval. The Commission also reviewed administrative and fiscal matters and approved the research plans for 1972 and the budget of fiscal year 1974. Mr. Neils M. Evens was elected Chairman and Mr. Martin K. Eriksen the Vice Chairman for 1972. Mr. Haakon M. Selvar submitted his resignation in 1972. He had been a United States Commissioner since 1964 and served as Chairman in 1966 and 1970. Mr. Robert W. Schoning and Mr. William S. Gilbert were appointed as United States members of the Commission.

During the 1972 fishing season, the Commission periodically reported the cumulative catches from each regulatory area and announced the closing dates for Areas 2, 3A and 3B.

The Commission met in Seattle in September to review the 1972 halibut fishery in the Bering Sea and to consider staff and industry proposals for that area in 1973. The regulations proposed by the Halibut Commission also were proposed by the International North Pacific Fisheries Commission and approved by the member governments: Canada, Japan and the United States.

In addition to the Annual Report for 1971, the Commission published Scientific Report No. 54 and prepared articles for other journals. Technical papers were prepared at the request of the Canadian and United States national sections of the International North Pacific Fisheries Commission. The publications are listed at the end of this report.

Expenditures for the 1971-72 fiscal year (April-March) were \$492,000. In compliance with the Convention, expenses of the Commission were shared equally by both governments.



HAARON M. SELVAR  
U.S. Commissioner 1964-1972

## Director's Report

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Stocks of halibut continued to decline in 1972 and since 1960 the catch per 100 hooks has declined 30% in Area 2 and 50% in Area 3. In 1972 the catch limit was reduced by 13 million pounds in an attempt to halt the decline but the benefit of this reduction will not be realized before 1973. However, considering losses to trawl fisheries as well as the longline fishery, the catch in 1972 was excessive and unless the stocks improve in 1973, a further reduction of catch will be necessary in 1974.

A highlight of the 1972 season was the dockside price of halibut. Prices were almost double those of 1971. In recent years the price of medium (10 to 60 pounds) and large (over 60 pounds) halibut ranged from 35 to 40 cents per pound and the price of chicken halibut (5 to 10 pounds) was 30 cents per pound or less. In 1972 the price of medium and large halibut reached 85 cents per pound and averaged 64 cents for the season. Chicken halibut averaged 35 cents per pound but sold for as much as 70 cents per pound.

Another event significant to the halibut industry during 1972 was the volume of halibut imported from Japan. In earlier years these imports amounted to 3 to 6 million pounds (equivalent dressed weight); in 1972 the volume reached 20 million pounds — one-half the North American production. Most of the Japanese imports were fillets and many of those that were examined were from halibut below 5 pounds, the minimum size established by the Halibut Commission (I<sub>H</sub>C). The International North Pacific Fisheries Commission (I<sub>N</sub>P<sub>F</sub>C) also recognizes this size limit in the eastern Bering Sea and Japan has adopted the limit as a domestic conservation measure in the western Bering Sea. Although the exact source of the imported halibut is uncertain, the volume exceeds the annual Japanese production in the western Pacific and apparently most of the imports originated in the Bering Sea — in apparent violation of the established minimum size. Furthermore, analyses of recent data obtained by the U.S. National Marine Fisheries Service showed evidence that Japanese trawlers have been retaining halibut in the eastern Bering Sea during the last 5 years — in apparent contravention to I<sub>N</sub>P<sub>F</sub>C conservation measures. Commissioners of I<sub>H</sub>C have notified the governments of Canada and the United States about these problems and have urged action to remedy the situation.

Research on hook-spacing of longline gear continued and confirmed last year's results that stock abundance had been overestimated during the 1960's. Analyses are now directed towards establishing a new standard for measuring catch per unit of effort.

# The Fishery

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## REGULATIONS

The Pacific Halibut Fishery Regulations for 1972 were approved by the Secretary of State of the United States of America on February 17 and by the Governor General of Canada on March 14. As in previous years, these regulations also implemented the conservation measures adopted by the International North Pacific Fisheries Commission for the eastern Bering Sea on behalf of Canada and the United States.

### Regulatory Areas

The regulatory areas in 1972 were (*see Figure 1*):

- Area 2 — All Convention waters south of Cape Spencer, Alaska.
- Area 3A — Cape Spencer to Kupreanof Point near the Shumagin Islands.
- Area 3B — South of the Alaska Peninsula and the Aleutian Islands between Kupreanof Point and the meridian of 175° W.
- Area 3C — South of the Aleutian Islands and west of 175° W.
- Area 4A — A triangle in the Bering Sea east of 170° W., south of a line between Cape Sarichef and Cape Navarin and north of a line from Cape Sarichef to a point at 54° N. of the meridian of 170° W.
- Area 4B — The Bering Sea side of the Aleutian Islands between Cape Sarichef and the meridian of 170° W., south of Area 4A.
- Area 4C — The Bering Sea between 170° W. and 175° W. and south of a line between Cape Sarichef and Cape Navarin.
- Area 4D — The Bering Sea north of Areas 3C and 4C and north of a line between St. Paul Island and Cape Newenham.
- Area 4E — The southeastern flats in the Bering Sea, east of a line from Cape Sarichef to St. Paul Island and south of a line between St. Paul Island and Cape Newenham.

### Catch Limits and Length of Seasons

The catch limits in 1972 were 13 million pounds less than in 1971. This change in the catch limit was the largest ever introduced by the Commission. The reduction was necessary to correct for the overestimate of stock abundance since 1960 and to reduce effort in an attempt to stop the decline of CPUE. (*See Condition of the Resource.*) In Area 2 the catch limit of 15 million pounds was a reduction of 5 million pounds from the previous year. Areas 3A and 3B were combined in 1972 and assigned



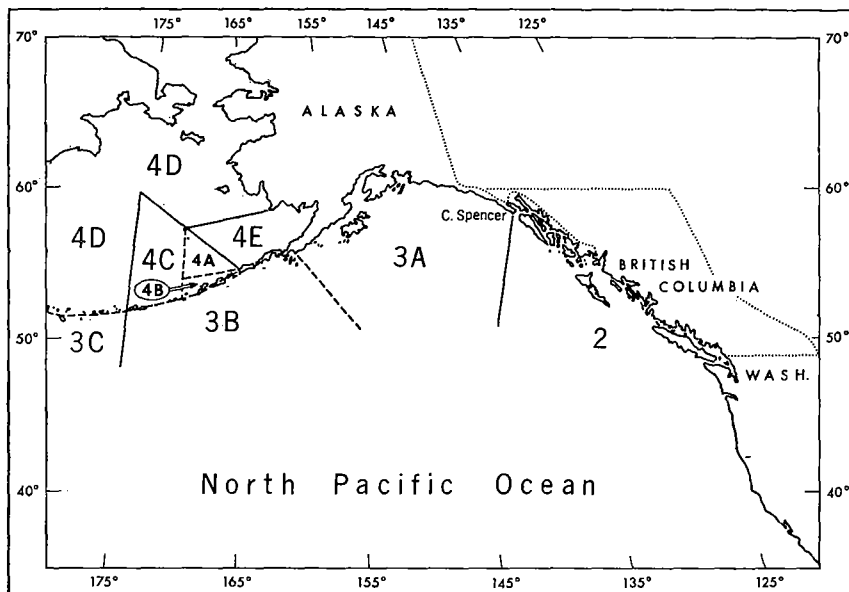


Figure 1. Regulatory areas of the Pacific halibut fishery in 1972.

a catch limit of 25 million pounds—a reduction of 8 million pounds from the catch limit in 1971 (30 million pounds in Area 3A and 3 million pounds in Area 3B). All other regulatory areas were managed by limiting the length of the fishing seasons without assigning catch limits.

The opening and closing dates and the number of fishing days in 1971 and 1972 are compared in Table 1. As in previous years, the fishing seasons commenced at 1500 hours (Pacific Standard Time) in Areas 2, 3A and 3B and at 1800 hours in all

Table 1. Opening and closing dates by area, 1971-1972.

Area	Opening		Closing		Fishing days	
	1971	1972	1971	1972	1971	1972
2	March 17*	March 17*	May 7*	May 1*	51*	45*
	May 7	May 1	Nov. 1	August 10	178	101
3A	May 7	May 1	Nov. 1	Sept. 14	178	136
3B	April 4	March 29	April 9	April 3	5	5
	May 7	May 1	Nov. 1	Sept. 14	178	136
3C	March 17	March 17	Nov. 15	Nov. 15	242	242
4A	March 22	March 17	April 4	April 4	12	17
4B	March 22	March 17	April 4	April 4	12	17
	Sept. 1	Sept. 1	Sept. 14	Sept. 14	12	12
4C	March 17	March 17	April 4	April 4	17	17
	Oct. 1	Oct. 1	Oct. 17	Oct. 17	15	15
4D	March 17	March 17	Nov. 15	Nov. 15	242	242

\* Special permit season south of Willapa Bay.

other areas; on the last day of the season in each area, fishing ended at 0600 hours. In addition to the regular seasons, special permits were granted to longline vessels to fish in the southern part of Area 2 (south of Willapa Bay, Washington) from March 17 to May 1.

### **Gear Restrictions**

Dory gear has been prohibited as a means for catching halibut since the early 1930's because it tended to catch smaller fish than longline gear. The regulation read as follows: "The use of any hand gurdy or other appliance in hauling halibut gear by hand power in any dory or small boat operated from a vessel licensed under the provisions of these regulations is prohibited in all convention waters." The prohibition was deleted from the 1972 regulations because the old method of dory fishing is no longer used.

The regulation which prohibits the retention of halibut taken by nets was changed to include pot gear as well as nets. These types of gear are selective for fish below the optimum size.

### **Bering Sea Regulations**

Regulatory measures for the Bering Sea halibut fishery have changed markedly during the past 15 years. From 1958 to 1962 the fishery expanded geographically as vessels discovered new fishing grounds. Catches increased from 2 million pounds in 1958 to 7 million pounds in 1962 and the number of vessels increased from 21 to 76. During this period, the fishing season opened in late March or early April and remained open into October. No catch limit was imposed as excessive exploitation was not considered possible with the size of the available fleet.

Japan entered the halibut fishery in the southeastern Bering Sea in 1963 after IANPFC agreed that halibut in that region no longer qualified for abstention. Initial regulations for the three-nation fishery included a catch limit and a statutory closing date if the catch limit was not taken. In 1963 a catch limit of 11 million pounds was adopted and in 1964 it was reduced to 6.4 million pounds. In both years the opening date was March 25 and the statutory closing date was October 15.

Beginning in 1965, and in each year since, the Bering Sea fishery has been regulated by length of season in lieu of catch limits. Several areas were defined and the fishing seasons established to permit a controlled fishery. The major objectives of the regulations during this period were to allow the stocks to recover from the excessive removals in 1963 and 1964, to maintain a fishery sufficient to provide an appraisal of stock condition, and to permit vessels to explore the fishing potential in new areas. From 1965 to 1971, the catches averaged less than 1.5 million pounds annually.

The stocks have not responded to the severe restrictions placed on the setline fishery and in the last few years the complicated area and season structure of the Bering Sea regulations have become an unnecessary burden. The number of vessels in the fishery has declined steadily as fishermen have been discouraged with small catches and the short seasons have not provided adequate opportunity for vessels to explore the potential of other grounds. Consequently, the quantity of data available for analysis of stock condition has been inadequate. Accordingly, the Commission has been gradually working toward a consolidation of areas and seasons to simplify the regulations.

The regulations proposed for the Bering Sea fishery in 1973 are a further step toward simplification. In Areas 4A, 4B and 4C the opening and closing dates would be the same to provide a free choice of grounds for the vessels. The spring fishery would open on April 1 for 18 days and a fall fishery on September 15 for 15 days. The fall opening would permit vessels to fish grounds which were inaccessible at that time under previous regulations. The April 1 opening would be 14 days later than in 1972 to avoid the severe ice conditions experienced during the past 2 years.

### STATISTICS OF THE FISHERY

#### Catch by Regulatory Area

The total catch of halibut in 1972 was 43 million pounds—the lowest in the history of halibut regulation and 3 million pounds less than in 1971. Most of the reduction occurred in Area 3.

The 1972 catches by country and regulatory area are compared with catches from 1968 to 1971 (*Table 2*). In Area 2 the catch was 16.3 million pounds, approximately the same as in 1971. The geographical distribution of the 1972 catches in Area 2 was similar to that of the previous year. The British Columbia coast produced 10.0 million pounds in both years. In Areas 3A and 3B the catch was 25.9 million pounds, 3.1 million pounds less than in 1971; only 11,000 pounds were caught in Area 3C. The Bering Sea (Area 4) catch was 867,000 pounds; 80,000 in Area 4A, 155,000 in Area 4B, 94,000 in Area 4C and 538,000 in Area 4D. Severe weather and drifting pack-ice again restricted fishing effort in the spring fishery in the Bering Sea.

Table 2. Catch of halibut in thousands of pounds (eviscerated, heads-off) by regulatory areas, 1968-1972.

Regulatory Area	1968	1969	1970	1971	1972
<b>AREA 2</b>					
Canada .....	10,666	13,346	11,147	10,189	10,517
United States .....	5,971	9,362	8,738	6,584	5,765
Total .....	16,637	22,708	19,885	16,773	16,282
<b>AREA 3</b>					
Canada .....	18,135	19,583	17,119	14,578	11,757
United States .....	12,747	15,081	16,800	14,437	14,112
Total .....	30,882	34,664	33,919	29,015	25,869
<b>AREA 4</b>					
Canada .....	668	668	889	729	261
United States .....	653	565	245	137	606
Total .....	1,321	1,233	1,134	866	867
<b>ALL AREAS</b>					
Canada .....	29,469	33,597	29,155	25,496	22,535
United States .....	19,371	25,008	25,783	21,158	20,483
Total .....	48,840	58,605	54,938	46,654	43,018

The U.S. catch was over 70% of the total until 1945, but that percentage declined to 40% by 1968. The Canadian portion of the catch has decreased during the past 4 years but still exceeds 50% of the total.

### Landings by Ports

The distribution of landings by port in 1971 and 1972 are given in Table 3. Prince Rupert continued as the leading port, accounting for nearly 11.5 million pounds, about 27% of the total landings. Kodiak was second with 9 million pounds (20%) of the landings and Seward was third with 5 million pounds. Seattle landings which were as high as 40% of the total in the late 1930's have declined steadily and, by 1972, were less than 1 million pounds, only 2% of the total landings. This decline occurred because Area 3 vessels were landing their catches in Kodiak and Seward rather than in Seattle and because of fewer Seattle-based vessels fishing in Area 2.

Table 3. Canadian and United States landings in thousands of pounds by port, 1971-1972.

Region or Port	1971			1972		
	Canada	U.S.	Total	Canada	U.S.	Total
CALIFORNIA and OREGON .....	3	69	72	—	68	68
WASHINGTON						
Bellingham .....	1,940	724	2,664	1,185	568	1,753
Seattle .....	111	1,894	2,005	1	675	676
Other .....	—	201	201	—	229	229
BRITISH COLUMBIA						
Prince Rupert .....	11,279	1,568	12,847	10,121	1,301	11,422
Vancouver .....	3,996	—	3,996	3,483	—	3,483
Vancouver Island .....	520	—	520	693	—	693
Other .....	438	—	438	1,153	—	1,153
SOUTHEASTERN ALASKA						
Petersburg .....	61	2,528	2,589	55	2,463	2,518
Ketchikan .....	23	2,348	2,371	—	970	970
Juneau .....	13	1,220	1,233	—	1,047	1,047
Pelican .....	581	865	1,446	463	679	1,142
Sitka .....	124	1,139	1,263	70	1,150	1,220
Other* .....	—	811	811	—	815	815
CENTRAL ALASKA						
Kodiak .....	4,792	4,425	9,217	3,352	5,355	8,707
Seward .....	1,169	2,442	3,611	1,637	3,499	5,136
Sand Point .....	408	276	684	322	708	1,030
Other** .....	38	648	686	—	956	956
TOTAL .....	25,496	21,158	46,654	22,535	20,483	43,018

\* Craig, Hydaburg, Metlakatla, Tokoen and Wrangell.

\*\* Cordova, Homer, Ninilchik, Port Williams, Soldatna, Valdez, Whittier and Yakutat.

### Value of Catch

The 1972 halibut catch had a record value of over \$25 million, in contrast to a value of \$15 million in 1971. The previous record was \$23 million in 1969. The higher value in 1972 was achieved in spite of the reduced catch because the price of halibut paid to fishermen was the highest in the entire history of the fishery. The average price per pound of medium-sized halibut was 60 cents in Kodiak and 65 cents in Prince Rupert, Vancouver and Seattle.

## Number of Vessels and Fishermen

Most of the halibut catch is taken by large setline vessels called the "regular fleet." Thousands of unlicensed vessels (mostly trollers) also land halibut but are not included in the "regular fleet." A special study on the unlicensed vessels is presented in the section on Scientific Investigations.

In 1972, 38 vessels were added to the regular fleet, bringing the total number to 382, the largest in the past 5 years (Table 4). The number of fishermen in the regular fleet has not changed much in recent years and was 1,560 in 1972.

Table 4. Number of "regular setline vessels" and men by area and country.

Year	Area 2		Area 3		Areas 2 & 3*		Total	
	Boats	Men	Boats	Men	Boats	Men	Boats	Men
CANADA								
1968	82	295	51	399	12	83	145	777
1969	80	287	48	370	16	108	144	765
1970	102	353	53	406	12	77	167	836
1971	92	338	50	383	12	76	154	797
1972	109	370	41	296	15	96	165	762
UNITED STATES								
1968	87	295	68	357	7	30	162	682
1969	117	378	63	340	10	49	190	767
1970	127	413	71	361	13	53	211	827
1971	105	341	64	329	21	90	190	760
1972	110	343	88	380	19	75	217	798
CANADA AND UNITED STATES								
1968	169	590	119	756	19	113	307	1,459
1969	197	665	111	710	26	157	334	1,532
1970	229	766	124	767	25	130	378	1,663
1971	197	679	114	712	33	166	344	1,557
1972	219	713	129	676	34	171	382	1,560

\* Vessels that fished both areas.

## CONDITION OF THE RESOURCE

### Catch Per Unit Effort (CPUE)

A new measure of CPUE was adopted last year to correct for the effects of hook-spacing on longline gear. Recent studies have shown that the catch per hook increases with hook-spacing and that more of the wider spaced gear is being used by the fleet. Before 1950 most of the fleet used 13-foot spacing between the hooks. By 1960 most of the gear was rigged at 18-foot intervals and more recently 21-foot gear has been the most common. In 1972 many vessels, particularly in Area 3, fished with 26-foot gear.

A comparison of the catch per hook (CPUE) of the different gear by area and year shows that each gear experienced a similar decline of stock abundance. To obtain a single measure of CPUE, gear with different hook-spacing has been equated with the catch per 100 hooks of 18-foot gear. This measure of CPUE demonstrates a serious decline in abundance in Areas 2 and 3 since 1960 (Table 5). The CPUE declined 18% in Area 3 and 12% in Area 2 in 1972, despite quota reductions during earlier years. The effect of the large reduction of the catch limit in 1972 will not be known until the 1973 season.

Table 5. Catch in pounds per 100 hooks, all gear standardized to 18-foot gear.

Year	Area 2	Area 3	Year	Area 2	Area 3
1960	103	164	1967	87	117
1961	96	165	1968	89	116
1962	84	145	1969	88	106
1963	81	129	1970	86	103
1964	83	124	1971	82	97
1965	87	112	1972	72	79
1966	88	116			

The mean age of halibut in both areas also has declined and is of particular concern in Area 2 as described in the following section.

### Age Composition

The age composition (by weight) of halibut from the major regions of the coast in 1970-1972 is summarized in Table 6.

In Area 2 the catch south of Dixon Entrance had a higher proportion of young fish than the catch in southeastern Alaska. The 1964 and 1965 year classes (7- and 8-year olds) accounted for 30% of the landings in British Columbia whereas in southeastern Alaska these groups contributed only 24%. In Hecate Strait nearly 70% of the fish were under 9 years old compared to less than 30% in southeastern Alaska. The 1961 year class (11-year olds), which dominated the catch in recent years, is not important in landings from central Hecate Strait although it is still strong in other areas. The modal age of halibut in setline landings from Hecate Strait has been as low as 5 in recent years but in southeastern Alaska it has ranged from 8 to 11 (Figure 2). These differences may be a consequence of continued high removals from south of Dixon Entrance despite reductions in the quota for Area 2 as a whole.

Table 6. Age composition of halibut in 1972 and mean age by region, 1970-1972.

Region	Age (1972)				Year		
	<9	9-11	12-14	>14	1970	1971	1972
	Percent				Mean Age		
Willapa Bay and South .....	39	29	15	17	—	10.3	10.6
Washington-Vancouver Island .....	47	31	11	11	10.6	8.9	9.7
Queen Charlotte Sound .....	48	17	20	15	9.0	7.8	10.5
Central Hecate Strait .....	68	22	6	4	7.5	7.5	8.1
Northern Hecate Strait .....	57	31	7	5	8.7	8.8	8.6
West Queen Charlottes .....	36	33	14	17	11.2	9.0	10.6
Inside S.E. Alaska .....	28	47	16	9	11.2	10.7	10.3
Outside S.E. Alaska .....	19	42	23	16	11.4	12.3	11.3
Cape Spencer-St. Elias .....	7	39	33	20	11.5	11.4	12.3
Portlock-Albatross .....	20	46	23	10	10.8	11.0	10.8
Chirikof-Semedi Islands .....	30	51	14	4	10.4	11.2	9.9
Shumagins and West .....	14	54	20	12	11.3	11.3	11.1
Bering Sea — 4A .....	27	36	21	16	10.4	10.4	11.0
Bering Sea — 4B .....	16	54	19	11	10.0	11.9	11.2
Bering Sea — 4C .....	—	—	—	—	13.9	12.8	—
Bering Sea — 4D .....	8	31	35	26	—	—	13.8

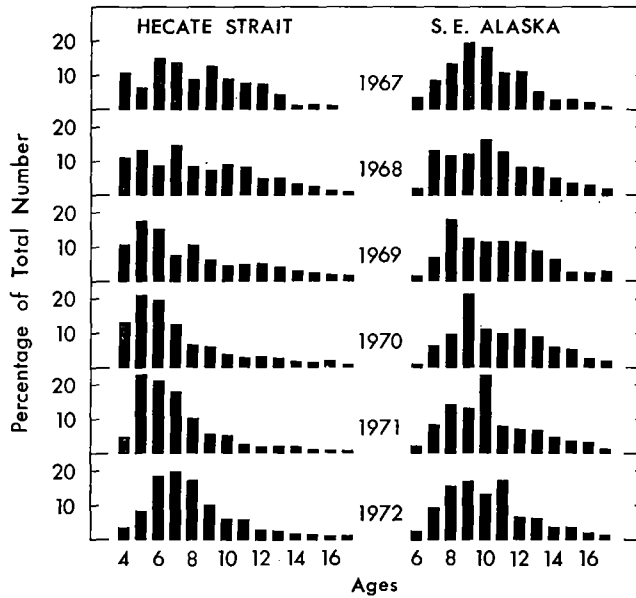
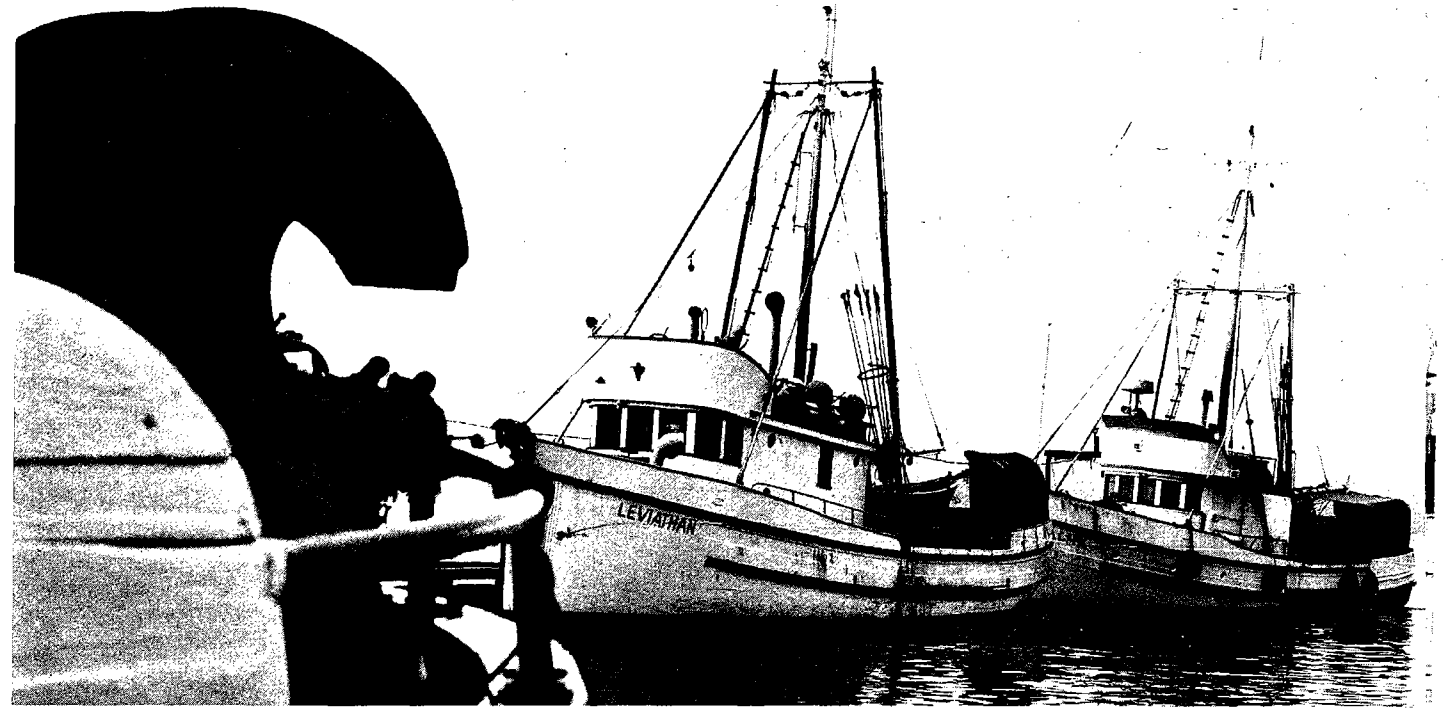


Figure 2. Age composition of halibut in Hecate Strait and southeastern Alaska.

Within Area 3 the age composition of halibut usually has been similar from different grounds, but in 1972 landings from Cape Spencer to Cape St. Elias contained a larger proportion of older fish (13 to 15 years) than other grounds, and young fish (7 to 9 years) were unusually abundant around the Chirikof-Semidi Islands. The 1961 year class remained dominant throughout Area 3 and accounted for 26% of the catch from grounds near the Shumagin Islands.

Severe weather during the spring fishery prevented fishing in Area 4C and only a few samples were obtained from Areas 4A and 4B, including those from a Commission charter vessel. In Area 4D the summer fishery caught more older fish than in recent years.

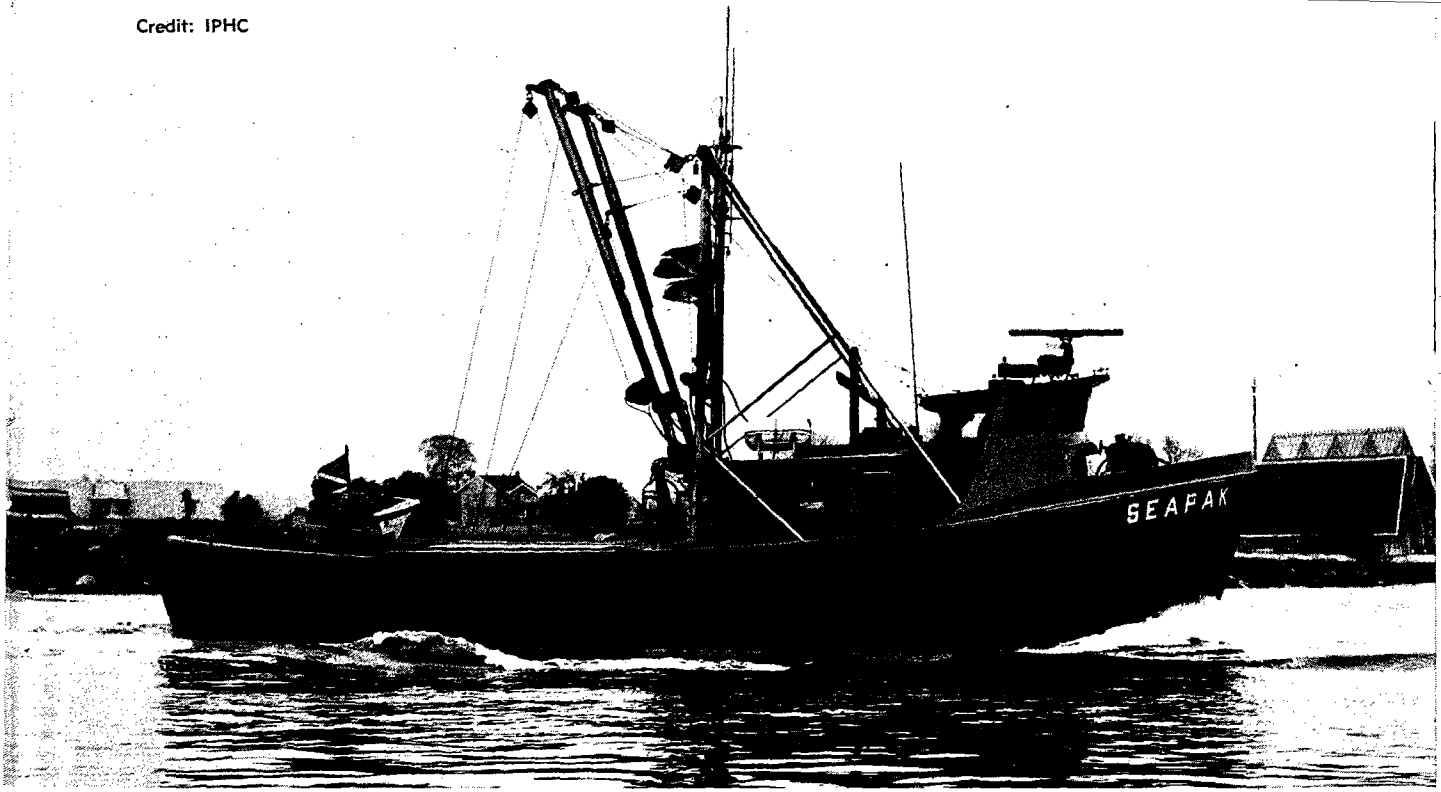


Halibut vessels in Ketchikan.

Unloading halibut in Vancouver.

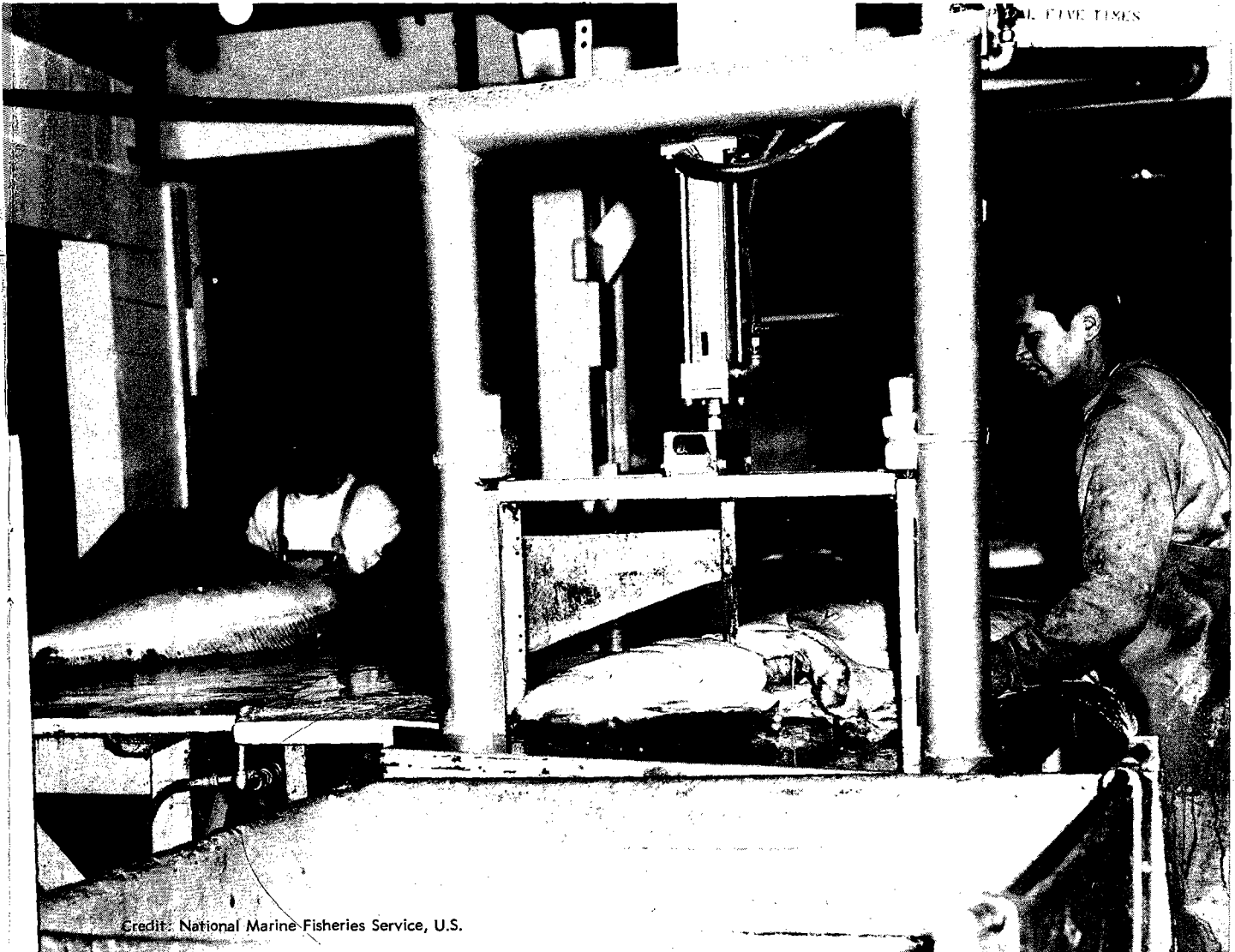






M/V SEAPAK (Vancouver), Commission Charter.

Guillotine for beheading halibut.



# Scientific Investigations

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## MINIMUM SIZE LIMIT

Before 1940 the Halibut Commission closed nursery areas and prohibited dory gear to protect small halibut. In 1940 the Commission also established a minimum size limit of 5 pounds dressed weight. This weight was the division between the trade categories of "baby" and "chicken" halibut and, although the total catch of baby halibut was small at that time, the measure stopped a few vessels from landing inordinate numbers of little halibut. An equivalent length limit of 26 inches was added in the 1944 regulations for the convenience of fishermen. In 1963 the 5-pound (26-inch) minimum size was adopted by the International North Pacific Fisheries Commission for the eastern Bering Sea (east of 175° W. longitude) and Japan established the same size limit for halibut caught by Japanese vessels in the western Bering Sea. In 1966 the North American industry proposed a larger size limit to provide more protection for small fish. The Commission questioned the anticipated benefits and did not adopt the proposal. More recently, reassessment of stock abundance and re-examination of other population parameters indicated that potential benefits could be realized by increasing the minimum size.

The growth rate of halibut has changed significantly since 1940 and today chicken halibut (5 to 10 pounds) are between 6 and 8 years old. The average female grows through the chicken category in 1.5 years compared with 3 years for males. The average age of chicken halibut is the same now as the average age of baby halibut in 1940 when the 5 pound size limit was established. For the 1973 fishing season, the minimum size limit will be raised to 32 inches, head-on, and 24 inches, head-off, which is equivalent to 10 pounds dressed weight (*Figure 3*). The new regulation

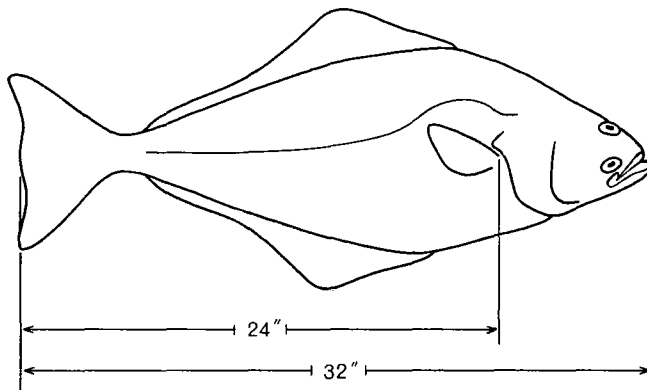


Figure 3. Minimum commercial size: with head-on, 32 inches; with head-off, 24 inches. (Effective in 1973 in Areas 2 and 3.)

does not specify a weight limit because in the past fish of legal length were often below the legal weight limit when the head was removed.

A direct benefit of the larger size limit will accrue from the rapid growth of young fish which may double their weight in 2 years. The increase in weight is expected to offset losses from natural mortality, the incidental catch by trawls and the setline release mortality. Setline-caught fish frequently sustain serious injury but the chance of their survival can be improved if fishermen handle the undersized fish carefully and release them as soon as possible. A high survival is expected from troll-caught halibut which usually are hooked in the forward part of the mouth and hauled in as soon as they are hooked.

A gradual shift of fishing effort away from "chicken grounds" is expected because the salable catch will be small and fishing will be more profitable elsewhere. Further, those chicken halibut that survive to be captured as mediums (over 10 pounds) will be more valuable to the fisherman. The expected change in yield and in stock composition will be gradual and benefits will accrue over a period of several years.

The size limit in the Bering Sea has not changed and will remain at 26 inches or 5 pounds in 1973.

#### EFFECTS OF FOREIGN TRAWLING

Halibut intermingle with other groundfish and are vulnerable to capture by bottom trawls. Japan and the Soviet Union have developed large trawl fisheries in the Gulf of Alaska. Their effort primarily has been directed at Pacific ocean perch although both countries also trawl for shrimp. The Soviet fishery began in 1962, developed rapidly until 1965 and has subsequently declined.

The Japanese fishery began in 1963 and has expanded slowly but has not yet reached the intensity of the Soviet fishery. As a member of the International North Pacific Fisheries Commission, Japan's fishermen are required to release all halibut caught in the Gulf of Alaska, but Soviet fishermen are not prohibited from retaining trawl-caught halibut. Halibut that are caught by large trawlers and then released have a low survival as the fish are not released promptly. Statistics on the catch of halibut by these foreign fisheries are lacking, but can be estimated from the incidence of halibut observed in the catch of Japanese trawlers. The catch of Pacific ocean perch and shrimp and effort data from Japanese and Soviet trawlers in the Gulf of Alaska were used to estimate the losses in yield of halibut to the Canadian and United States fishery. These estimates do not include the losses due to the North American trawl fishery in British Columbia or the foreign trawl fishery in the Bering Sea.

The U.S. National Marine Fisheries Service provided the Commission with catch data from 3,000 hauls collected by observers aboard 19 Japanese trawlers in the Gulf of Alaska from 1963 to 1969. The data for each haul included the number and size of halibut, the hours trawled, the catch of Pacific ocean perch and shrimp. No information was available on the incidence of halibut in Soviet trawls. The annual catch of halibut by Japan was estimated by multiplying the number of halibut caught per hour trawled by the total number of hours trawled in each area by season. Groundfish and shrimp trawls caught an average of 10 halibut per hour, but the rate of catch varied considerably by area and season. The Soviet catch of halibut could not be estimated in the same way because the fishing effort of the Soviet fleet was unknown. However, estimates of the annual Soviet catch of Pacific ocean perch and shrimp were available.

These data were used to estimate the catch of halibut, assuming that the proportion of halibut was the same as in the catches of Japanese trawlers, three halibut per metric ton of Pacific ocean perch; 30 halibut per metric ton of shrimp.

The estimated Japanese and Soviet incidental catch of halibut in the Gulf of Alaska increased from 216,000 fish in 1962 to 1,470,000 in 1965 and then decreased to 566,000 in 1969 (Figure 4). Most of this catch was from the Soviet fishery and the decline in catches after 1965 was the result of a reduction in Soviet effort. Halibut in the Japanese catch were generally less than 80 cm long and 8 years old; in contrast, most of the halibut caught by the North American setline vessels are larger and older. If there were no losses to the foreign trawlers, some of the halibut would have died naturally and others would have grown and eventually been caught by North American setliners. The loss in yield to the setline fishery was estimated by using rates of growth, natural death and setline fishing mortality. The estimated annual loss due to the 1962-69 foreign trawl catch in the Gulf of Alaska increased from 0.3 million pounds in 1963 to 7.5 million in 1970. The loss occurs over a 20-year period, but about 60% of the loss occurs during the first 5 years. If the trawl fishery had ceased completely in 1969, the annual loss would decline to less than a million pounds by 1980. If the foreign trawl catch stabilizes at the 1969 level, future losses will be about 6.5 million pounds annually.

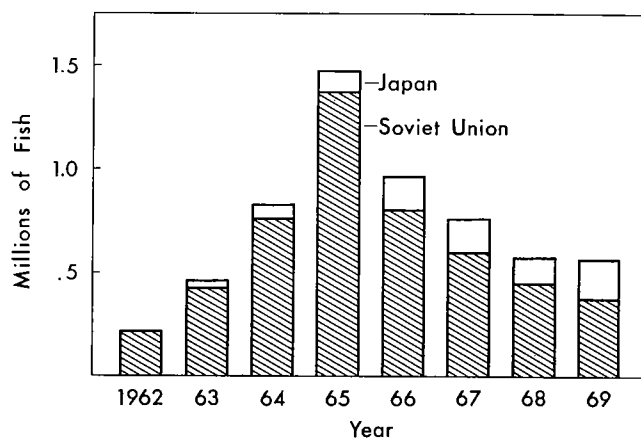


Figure 4. Estimated catch of halibut by Japan and the Soviet Union in the Gulf of Alaska.

The reliability of the estimates of yield loss depends on the accuracy of the estimates of trawl catch and the incidental catch of halibut. Estimates for the Soviet fishery are less reliable than those for the Japanese fishery because they are based on observations from Japanese vessels. Soviet trawls are lighter than the Japanese gear and fish slightly above the bottom. This difference in gear and fishing technique probably reduces the incidence of halibut in Soviet trawls, but observations on Soviet trawlers are needed to determine the precise rate of catch. Even if the incidence of halibut in Soviet trawls is one-half that of the Japanese, the annual loss in yield to the North American setline fishery would still be substantial (4 million pounds). These losses must be considered in assessing stock conditions and regulating the North American fishery.

## MORTALITY OF TRAWL-CAUGHT HALIBUT

Trawl-caught halibut were tagged and released in 1970 to estimate mortality due to trawl capture. The physical condition of each fish was judged on muscle tone and ability to close the operculum. The releases and subsequent recoveries are summarized in Table 7. Large fish were usually in better condition when released than small fish. An analyses of variance (randomized block design) showed that the recovery rate differed significantly by length and condition of the fish. The recovery rate was higher for fish over 65 cm than for fish under 65 cm. Approximately 70% of the recoveries were from setliners which select larger fish than trawlers or trollers. The relation of recovery rate to the condition of the fish on release indicates that the criteria were meaningful but not entirely accurate, as 11 fish recorded in the poor category as "dead" were subsequently recovered. More recoveries are expected in 1973.

Table 7. Length and condition of fish at release and rate of recovery, 1970-1972.

Length (cm)	Condition of fish on release							
	Good		Fair		Poor		Total	
	Number tagged	Percent recovered	Number tagged	Percent recovered	Number tagged	Percent recovered	Number tagged	Percent recovered
<65	163	11	272	8	289	3	724	7
65-79	325	22	393	19	270	5	988	16
>79	222	23	184	21	154	10	560	19
Total	710	20	849	16	713	5	2,272	14

## BIOSTATISTICS

### Catch Sampling

The sampling of commercial halibut landings was increased in 1972 to obtain more information on the size and age composition of landings by small setline vessels and salmon trollers. A new sampling scheme was implemented on a trial basis.

Catches from 733 trips were sampled at landing ports between Seattle, Washington and Kodiak, Alaska. Approximately 72,000 fish were measured and 20,000 otoliths (ear bones) were collected for age and growth studies. Another 15,600 fish were measured and 2,800 otoliths were collected at sea.

Length and age data obtained from sampling the landings should be representative of the commercial catch if estimates of population parameters are to be valid. Halibut are unloaded from the hold of a vessel by means of cargo slings holding approximately 1,500 pounds of halibut and six to eight fish are "randomly" taken from each sling throughout the unloading process. This method has serious disadvantages as samplers may be biased in the selection of large or small fish. An alternative scheme under consideration is to measure every fish in selected slings. The manner of loading the hold at sea and the order of unloading assures that most slings are a random sample of the catch and a more representative sample may be obtained than with the present sampling scheme. The sling sampling scheme was tested during 1972 and though the results indicate that the technique has merit, further analysis is needed to determine the reliability and practicality of the method.

Data were collected during the 1972 season to develop and evaluate a stratified sampling plan based on time, area and gear as criteria, as well as to determine the required sample size.

### **Otolith Length-Fish Length Relation**

Since 1933 the Halibut Commission has sampled commercial landings of halibut to gather age and length data. Otoliths were collected for age determination and fish were measured by 3-man or 4-man field crews. During the 1950's, alternative methods of obtaining the length data were considered to reduce the manpower required to measure fish.

In 1962 a new sampling program was initiated which required only one man to collect otoliths – fish lengths were then estimated from a regression equation which related the otolith radius to fish length. Measurement of the radius was slow and tedious and the nucleus of the otolith was difficult to locate. An obvious extension of the technique was to determine the relation between fish length and the more easily measured otolith length. In 1968 a linear regression was used to describe this relationship for all areas of the fishery and fish lengths were estimated in this manner. A review of the data in 1971 showed that the equation substantially overestimated the lengths of large fish and underestimated the lengths of small fish. In 1972 the data were re-examined and analyses made to ascertain whether a more adequate regression could be determined. Pairs of otolith and fish lengths were selected randomly from each of four broad geographical regions: British Columbia, southeastern Alaska, the Gulf of Alaska and the Bering Sea. Measurements were transformed logarithmically and fitted by a cubic equation for each region. The new regressions were tested statistically. These analyses indicated that separate regressions were needed for each regulatory area and that the new regressions eliminated any serious bias in the estimation of fish length that occurred with the equation introduced in 1968.

### **Unlicensed Halibut Fleet**

For the past several years the Conference Board, an advisory body to the Commission, has recommended that all vessels fishing for halibut be licensed by the Commission regardless of vessel size. The present regulations require that only setline vessels 5 net tons and larger be licensed. The purpose of licensing vessels is to obtain records of the fishery. Inherent with licensing is a procedure for obtaining clearances and filing a statistical return with the Customs Departments of both countries. The halibut regulations also require licensed vessels to maintain fishing logs showing location and number of skates fished. Most of the small, unlicensed setliners do not keep a fishing log. Before the present licensing procedures are changed, the numbers of vessels, fishing locations and type of gear must be known; this information has not been readily available in previous years for the unlicensed vessels.

The Pacific halibut fleet is large and diversified. In 1971 approximately 4,800 vessels landed halibut and only 570 were licensed by the Commission. The remaining 4,230 were either less than 5 net tons or were salmon trollers that are not required to be licensed. Of the 46.7 million pound catch in 1971, the licensed setliners produced 42.0 million pounds, the unlicensed setliners produced 2.7 million and salmon trollers produced 2.0 million. The percentages of the fleet and catch in 1971 and 1972 are shown in Figure 5. Only 14% of the fleet is licensed, but these vessels land nearly 90% of the catch. Though trollers outnumber small setliners by five to one, the landings by the two types of gear are nearly equal. Approximately 50% of the unlicensed vessels, both trollers and setliners, land only one or two trips. Most of the halibut caught by trollers appear to be purely incidental. Only 5% of the unlicensed vessels actively fish for halibut and land more than 10 trips. Most of the unlicensed vessels

fish primarily for salmon and do not fish the entire halibut season when salmon availability is high. Their movement in and out of the halibut fishery also depends on the price of salmon.

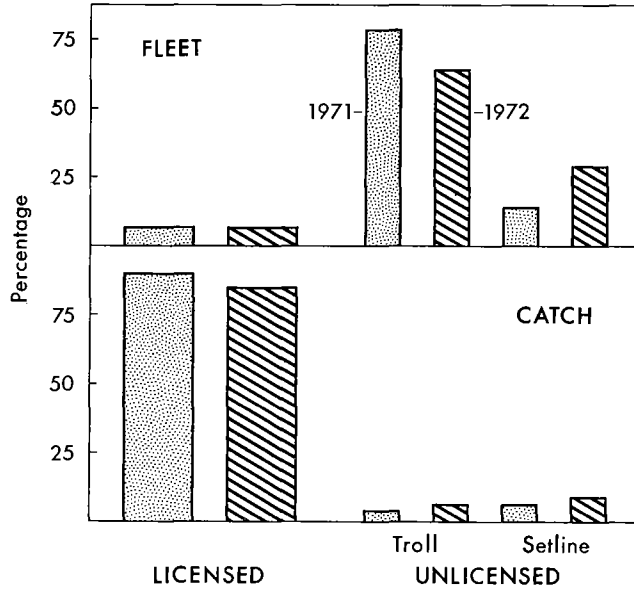


Figure 5. Composition of the fleet and their catch by license category, 1971 and 1972.

#### RECRUITMENT STUDIES

##### Survival of Juveniles

Surveys undertaken in 1963 and 1965 provided basic information on the distribution of juvenile halibut in the southeastern Bering Sea. This information was used to establish a series of stations which have been sampled annually since 1966. These stations are sampled in June with a small-mesh trawl. The mean catch in number of halibut per hour trawled has been used as an annual index of abundance. This index has declined from 31.8 in 1966 to 12.0 in 1972. Estimates for 1963 and 1965, although not strictly comparable, are included (*Figure 6*).

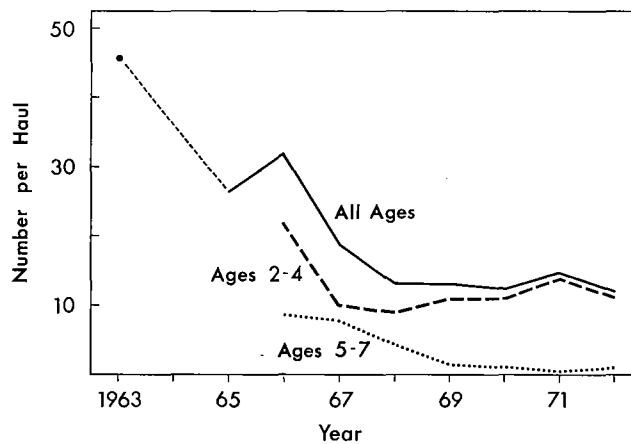


Figure 6. Annual abundance index of juvenile halibut in the southeastern Bering Sea, 1963-1972.

An age-length key is used to estimate relative abundance of each year class of juvenile halibut in the southeastern Bering Sea (Table 8). The abundance of 2-year old fish, although not fully recruited, usually is indicative of the strength of the year class. Halibut age 3 and older are fully recruited to the gear. The apparent abundance of 2-, 3- and 4-year-old fish has alternated yearly since 1966 and was above average in odd years and below average in even years. No explanation for this fluctuation is apparent. The abundance of 2- to 4-year-old fish, that are generally not available to commercial trawls, has generally improved since 1968, whereas the abundance of 5- to 7-year-old fish, that are regularly taken incidentally by trawls, has declined since 1966 (Figure 6). The large increase in foreign trawling in the area may account for the observed increase in mortality after age 4 and, therefore, for the continued decline in stock abundance.

Table 8. Relative abundance of juvenile halibut in the Bering Sea, 1966-1972.

Date	Number per hour trawled					
	Age 2	Age 3	Age 4	Age 5	Age 6	Age 7
1966	0.2*	16.8	4.8	7.4	0.9	0.2
1967	0.6	4.6*	4.9	6.4	0.6	0.7
1968	0.3	6.8	1.9*	3.2	0.5	0.5
1969	2.6	4.0	4.6	0.4*	0.7	0.2
1970	0.4	8.7	1.9	0.7	0.2*	—
1971	3.8	2.6	7.5	0.3	—	—*
1972	0.1	9.3	1.8	0.8	0.1	—

\* 1964 year class.

### Environmental Conditions

Weather stations throughout Alaska reported extremely low temperatures during the winter of 1971-72 as was evident in the ice conditions encountered by the Bering Sea halibut fleet in March 1972. Pack ice that completely covered the Area 4C grounds west of the Pribilof Islands made fishing impossible there during the early season. The northern part of Area 4A was open at the beginning of the season but the southward shift of the pack ice forced the vessels off the grounds and caused some loss of gear. Only the southern portion of Area 4A and 4B along the Aleutian Islands was open to fishing during the spring season. Air temperature at St. Paul Island during March averaged  $-11.7^{\circ}\text{C}$  which is  $7.4^{\circ}\text{C}$  less than the long-term mean for March recorded by the U.S. Environmental Data Service. Effects of the severe winter were still evident in June as some of the sampling stations were still covered by ice. Juvenile halibut were caught during June at these stations in earlier years. In 1972 most of the stations in Bristol Bay had bottom temperatures of  $0^{\circ}\text{C}$  or less; no juvenile halibut were taken at these stations. Air and water temperatures in June were lower than those encountered in any previous year.

The severe environmental conditions in the Bering Sea during 1971 and 1972 apparently have had a deleterious effect on the 1971 year class which averaged only 7 cm long compared to the long-term average of 11 cm. The catch of the 1971 year class in 1972 was only 0.2 fish per haul, the lowest recorded for 1-year olds since the surveys began in 1967.

The water in the Gulf of Alaska also was colder than usual but not as cold as in the Bering Sea.



### TAGGING EXPERIMENTS

Tag returns in 1972 totaled 794, of which 789 were released after 1964. Six \$100.00 rewards were paid in 1972, bringing the total to 46 since this premium-reward program was initiated in 1966. (Except for these special tags, the reward is \$2.00.) Japanese vessels recovered 83 tags that had been released by the Commission. North American vessels reported three tags released by the Fisheries Agency of Japan. The information on these tags was exchanged through the International North Pacific Fisheries Commission. Table 9 summarizes the tagging operations in 1972.

Table 9. Summary of tagging experiments, 1972.

Vessel	Gear	Area of Release	Number tagged
REPUBLIC	Setline	Bering Sea: Areas 4A and 4C	82
REPUBLIC	Setline	Shumagin Gully	261
OCEAN STAR	Trawl	Unimak Island	1,038
ALASKA QUEEN II	Setline	Oregon	192
SILVER MIST, VISCOUNT and HELEN T	Troll	Southeastern Alaska, B.C. Coast	21
Total			1,594

#### Bering Sea

During July 1970, 2,185 juvenile halibut were tagged in the southeastern Bering Sea (54° 45' N., 164° 45' W.). These fish were caught and released in coastal waters of 16 to 30 fathoms. Nearly 90% of the fish were 3-year olds (1967 year class). In 1971 another 2,339 juvenile halibut were tagged in the same area. Nearly 50% of these releases also were from the 1967 year class. In 1971 and 1972, 24 of the tags were recovered in the vicinity of the release site. In addition, 55 tags were returned by the Fisheries Agency of Japan. Fifty-one of those fish were caught between December 1970 and March 1971, approximately 25 miles WSW of the release area at depths of 100 to 150 fathoms. The other four were recovered in May and July from fishing grounds farther to the west. Most of the fish recovered were 5 years old (1967 year class) and below the minimum size limit.

#### Gulf of Alaska

Since 1963, 25,000 halibut have been tagged in the Gulf of Alaska and over 400 have been recovered (Table 10). Analyses of these data have provided general information on movements of young halibut.

Table 10. Summary of tagging studies in the Gulf of Alaska, 1963-1971.

Location	Undersized at time of tagging			Legal at time of tagging		
	Number tagged	Number recovered	Percent recovered	Number tagged	Number recovered	Percent recovered
Shelikof Bay	1,964	49	2.5	57	13	22.8
Idaho Inlet	896	48	5.4	71	9	12.7
Cape Fairweather	796	16	2.1	106	20	18.9
Cape St. Elias	4,638	50	1.1	806	69	8.6
Cape Chiniak	4,686	18	0.4	822	13	1.6
Chirikof Island	7,015	22	0.3	1,654	86	5.2
Unimak Bight	1,018	2	0.2	115	0	0.0

The undersized fish (<65 cm) tagged at Shelikof Bay, southeastern Alaska, have shown the most consistent movement in that nearly 80% were recovered from more southerly grounds. One and two years after tagging, the recoveries were centered in Dixon Entrance although a few fish moved as far south as Cape Scott. Third- and fourth-year recoveries were concentrated in lower Hecate Strait and Goose Islands grounds and some were as far south as Cape Flattery. In contrast, 9 of the 13 legal-sized fish tagged at Shelikof Bay were recovered near the tagging area. Two were recovered from inside southeastern Alaska waters and only one moved to Goose Island.

Halibut tagged and released in Idaho Inlet and between Cape Spencer and Cape St. Elias were recovered mainly in the area of release. Less than 10% of the 200 fish recovered had migrated from the tagging area. Those that did migrate were recovered from locations as far south as Vancouver Island.

Undersized halibut tagged at Cape Chiniak, the eastern end of Kodiak Island, demonstrated strong migratory tendencies. Over 60% of those recovered moved from the tagging area and nearly 50% of these were recovered from the Goose Islands grounds and the west coast of Vancouver Island. Only one recovery was made from inside Dixon Entrance. Legal-sized fish did not move away from the tagging area.

Recoveries from more westerly grounds have not yet shown any definitive pattern of movement, although small fish show a greater tendency to move than large fish.

#### Estimates of Mortality

Between 1963 and 1966 a grid of stations in Areas 2 and 3 were fished with setline gear and halibut were tagged and released at these stations to compare the rate and distribution of recoveries of fish tagged on commercial fishing grounds. Because more recoveries are expected, the analyses on the data presently available are preliminary.

The entire grid was fished once in May and June and again in June, July and August. The total mortality rate was estimated from the annual decline in recoveries. Figure 7 shows an example from tagging done in 1963 between Cape Cleare and the Trinity Islands in the central Gulf of Alaska. The number of recoveries in each year are plotted as logarithms so the decline will approximate a straight line. The rate of recovery in 1964 and 1965 was less than the rate after 1966. This difference is attributed to the introduction of a premium reward plan in 1966. Under this plan, \$100 rewards are paid for a selected number of tags; the rate of tag return has improved under this system.

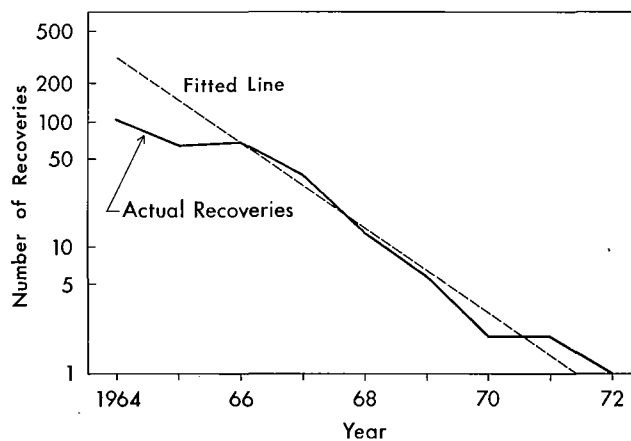


Figure 7. Survival of halibut tagged in Area 3, 1963.

The annual total mortality from the 1963 experiment was estimated at 0.537. This estimate is substantially higher than that from tagging experiments in the same region in the early 1950's. Similarly, the 1964 and 1965 grid experiments in western Area 3 indicate that total mortality has increased there also in recent years. Only a few recoveries are expected from these experiments in future years; hence, the results cannot be used to show whether the sharp reduction in the catch limit for Area 3 in 1972 will reduce the total mortality rate.

### HOOK-SPACING EXPERIMENTS

Four vessels were chartered during 1972 to continue studies on the relation between catch per unit effort (CPUE) and the spacing of hooks on longline gear. The *Republic* fished in the Bering Sea and in Shumagin Gully with gear having different hook-spacing, i.e. 13-, 21- and 42-foot gear. The results from the 380 skates that were fished confirmed previous findings that catch per hook increases with hook-spacing. The *Seapak* and *Cape Beale* fished 803 skates in northern British Columbia with 9-, 13- and 18-foot gear. The *Alaska Queen II* fished 341 skates off the coast of Washington and Oregon and used 18-, 36- and 42-foot gear. The results of the *Seapak*, *Cape Beale* and *Alaska Queen* experiments also confirmed the relation between catch per hook and hook-spacing, but on some of the trips the 18-foot gear did not show the expected increase in catch per hook. This difference may have been due to natural variation in the distribution of halibut or results may have been distorted by the high abundance of dogfish which were taken on the gear. Additional experiments are planned in Area 2 in 1973 to determine the significance of these exceptions.

Preliminary examination of the data from the 1971 and 1972 experiments indicate that the relationship between catch per hook and hook-spacing is not linear (*Figure 8*).

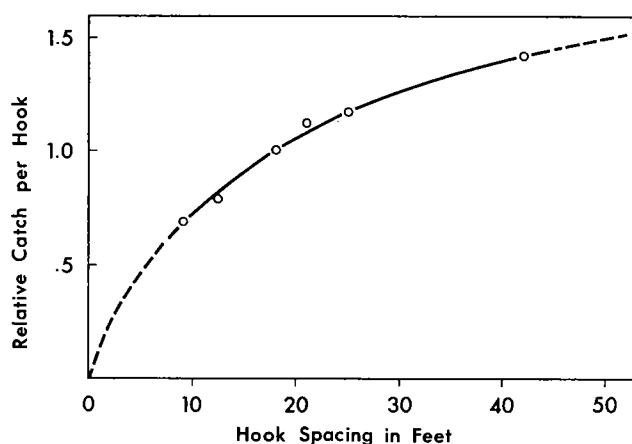


Figure 8. Relation of catch per hook to hook-spacing on longline gear.

### SEX COMPOSITION

Sex composition of halibut stocks was determined by sampling catches at sea. Preliminary examination of data from 1962-1972 showed that sex composition varied by gear and area. Males were over 50% of the setline catch in Area 2, but less than 25% of the catch in Area 3. In Hecate Strait the catch by trollers and trawlers was approximately 70% males.

Larger fish were caught in Area 3 than in Area 2 and larger fish were caught by setlines than by trawls and trolls. These differences in size composition by area and gear were partially responsible for differences in the sex composition; the percentage of males declined as the size of fish increased (*Figure 9*). This shift was probably due to the slower growth for males than for females. For each size the percentage of males was higher for trawls than for other gear but this difference may also be attributed to differences in location. For setlines, the percentage of males at each size was higher in Area 2 than in Area 3.

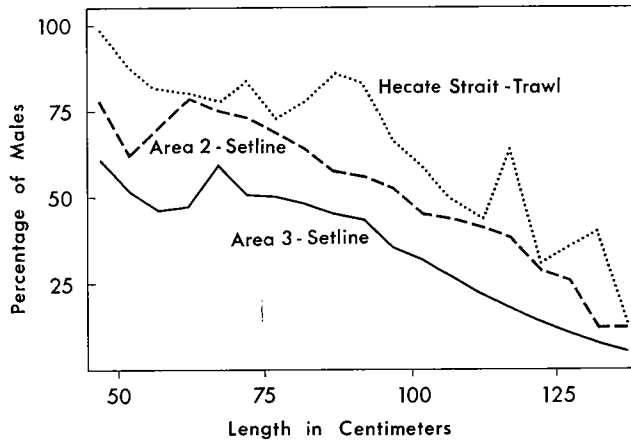


Figure 9. Percentage of males by length in Area 2 and Area 3.

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54. A reassessment of effort in the halibut fishery. Bernard E. Skud. 11 p. (1972).

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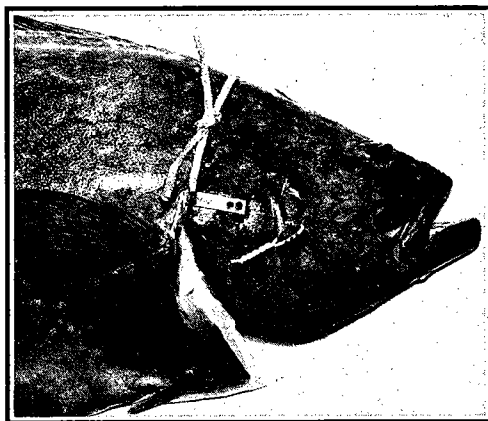
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1. Bait Experiments. 2 p. (1972).
2. Hook-Spacing. 2 p. (1972).
3. Length-Weight Relationship. 1 p. (1972).

# TAGGED HALIBUT

The INTERNATIONAL PACIFIC HALIBUT COMMISSION tags halibut with plastic tags and metal strap tags attached to the cheek on the dark side of the fish. Some fish have two tags. Retain all tagged halibut regardless of size or gear used.



## REWARD

**\$2.00 WILL BE PAID FOR THE RETURN OF THE TAGS AND RECOVERY INFORMATION FROM EACH FISH. \$100.00 WILL BE PAID FOR SPECIAL PRESELECTED TAGS.**

**WHEN YOU CATCH A TAGGED HALIBUT:**

1. Record Tag Numbers, Date, Location and Depth in your log book.
2. Leave Tags on the fish.
3. Mark the fish with a gangion.

**WHEN YOU LAND A TAGGED HALIBUT:**

1. Report fish to a Commission Representative or Government Officer  
or
2. Forward tags to address below and enclose recovery information (see above), your name, address, boat name, gear, overall length of fish and, if possible, earstones from the fish.

**FINDER WILL BE ADVISED OF MIGRATION AND GROWTH OF THE FISH.**

**International Pacific Halibut Commission**

P. O. Box 9  
University Station  
Seattle, Washington 98105

Tag Reward Poster.