

**REPORT OF THE INTERNATIONAL FISHERIES
COMMISSION**

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

NUMBER 6

**BIOLOGICAL
STATISTICS OF THE PACIFIC
HALIBUT FISHERY**

(1) CHANGES IN YIELD OF A STANDARDIZED UNIT OF GEAR

BY

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AND F. HEWARD BELL**

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FOREWORD

The present is a sixth report by the International Fisheries Commission upon scientific results obtained under the terms of the Convention of 1924 between the United States and Great Britain for the preservation of the halibut fishery of the Northern Pacific Ocean, including Bering Sea.

This is the first of the reports upon the biological statistics of the halibut fishery. It deals with the abundance of halibut upon the banks, their present condition, and history. It should be read in connection with Report Numbers 2 and 5, as forming a foundation for the recommendations of the commission outlined and discussed in Reports 1 and 7.

The International Fisheries Commission has had the help of an advisory board of four members: Dr. C. McLean Fraser, Dr. W. A. Clemens, Mr. N. B. Scofield, and the late Prof. John N. Cobb.

The investigations have been carried on by a staff under the direction of William F. Thompson, with headquarters and laboratory at the University of Washington, Seattle, U. S. A.

REPORTS BY THE INTERNATIONAL FISHERIES COMMISSION

1. Report of the International Fisheries Commission appointed under the Northern Pacific Halibut Treaty, by John Pease Babcock, Chairman, and Wm. A. Found, Miller Freeman, and Henry O'Malley, Commissioners. Dominion of Canada, Ottawa, 1928.
Same. Report of the British Columbia Commissioner of Fisheries for 1928, pp. 58-76. Victoria, 1929.
Same. Report of the United States Commissioner of Fisheries for 1930, Appendix 1. U. S. Bureau of Fisheries Document No. 1073. Washington, 1930.
2. Life History of the Pacific Halibut (1) Marking Experiments, by William F. Thompson and William C. Herrington. Victoria, B. C., 1930.
3. Determination of the Chlorinity of Ocean Waters, by Thomas G. Thompson and Richard Van Cleve. Vancouver, B. C., 1930.
4. Hydrographic Sections and Calculated Currents in the Gulf of Alaska, 1927 and 1928, by George F. McEwen, Thomas G. Thompson, and Richard Van Cleve. Vancouver, B. C., 1930.
5. The History of the Pacific Halibut Fishery, by William F. Thompson and Norman L. Freeman. Vancouver, B. C., 1930.
6. Biological Statistics of the Pacific Halibut Fishery (1) Changes in Yield of a Standardized Unit of Gear, by William F. Thompson, Harry A. Dunlop, and F. Heward Bell. In press.

Further reports will bear serial numbers and will be issued separately by the commission.

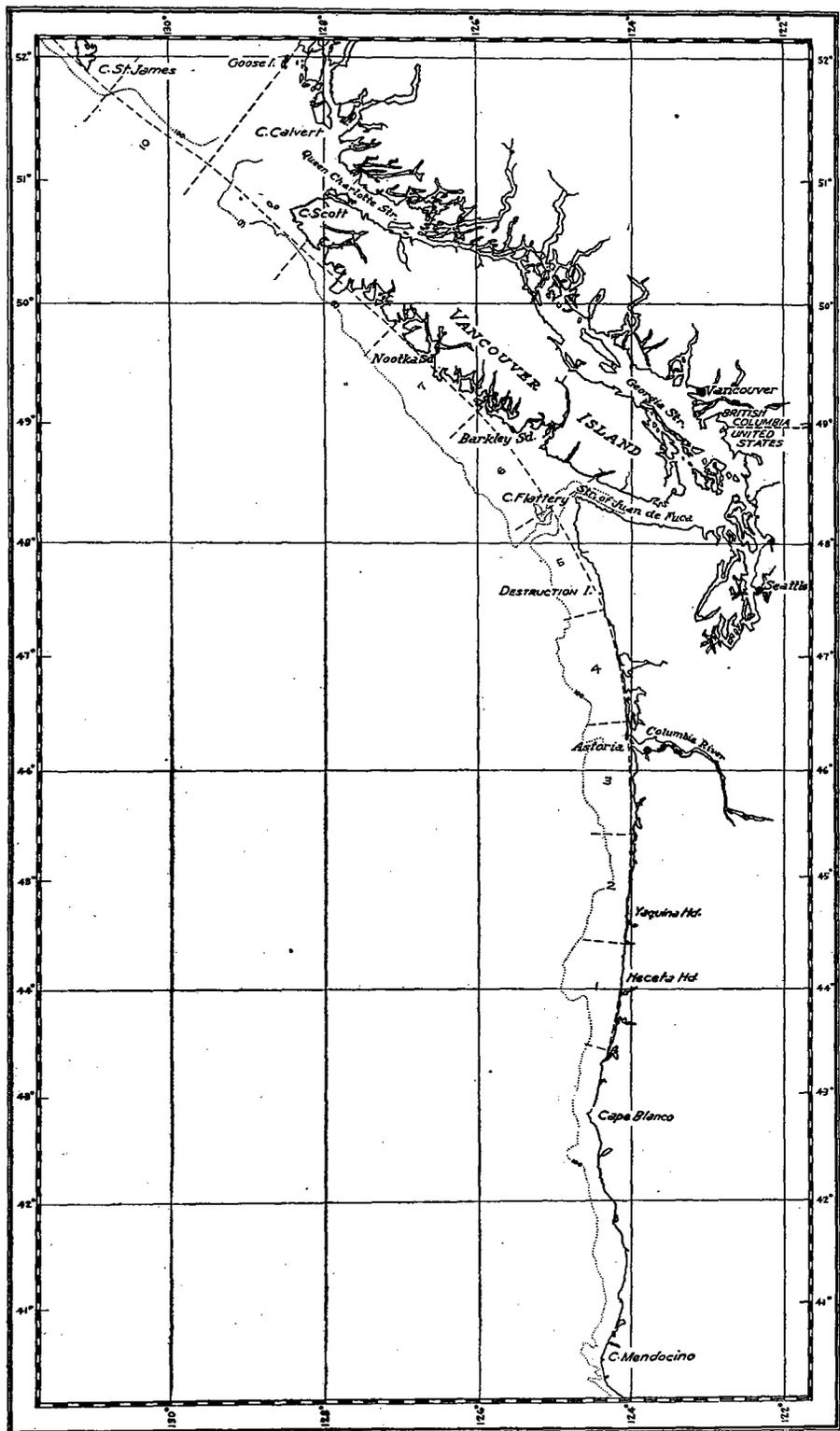


FIGURE 1.—Pacific Coast from Cape Mendocino to Cape St. James, showing the statistical areas by dotted lines.

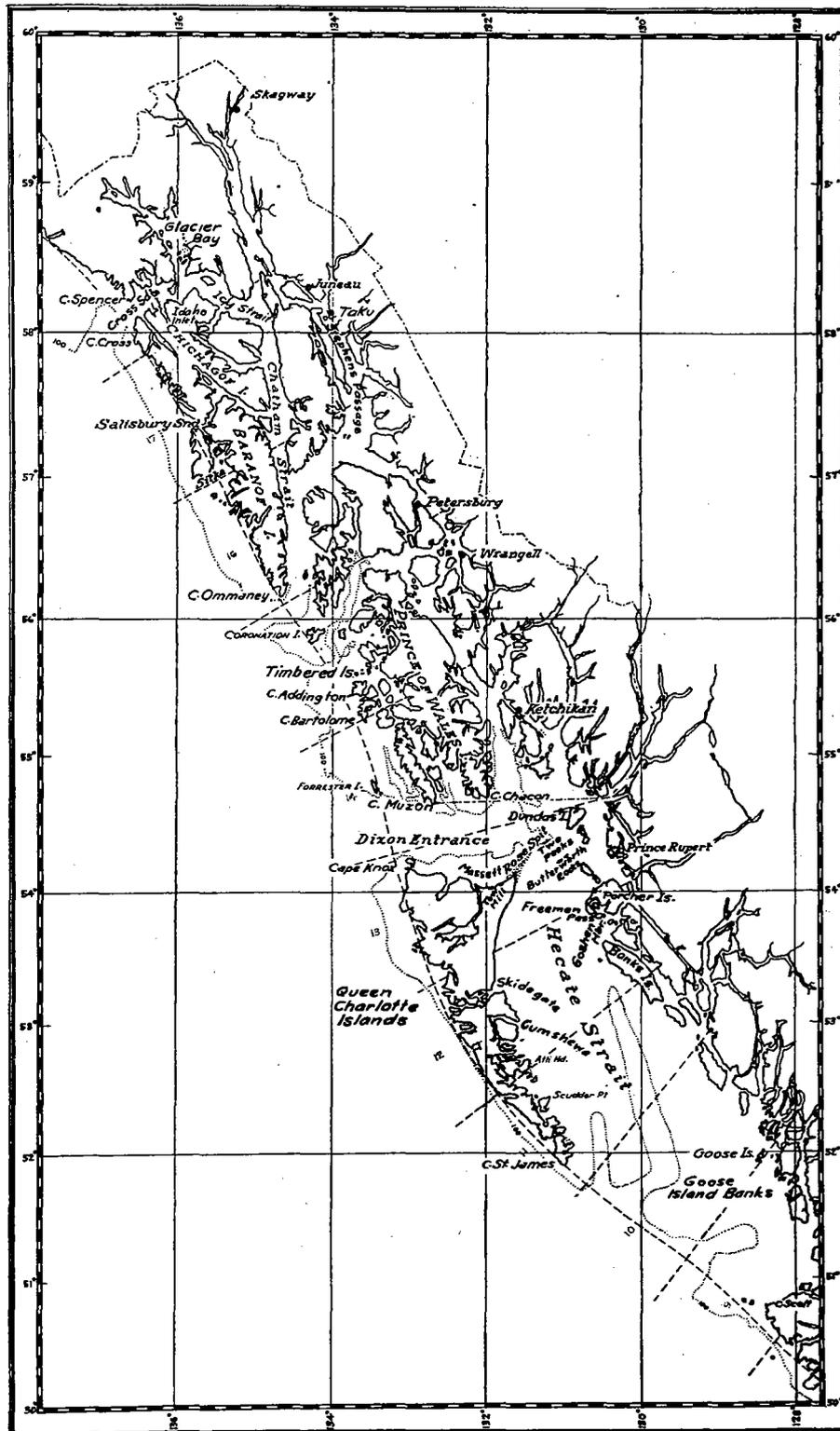


FIGURE 2.—Pacific Coast from Cape Scott to Cape Spencer, showing the statistical areas by dotted lines.

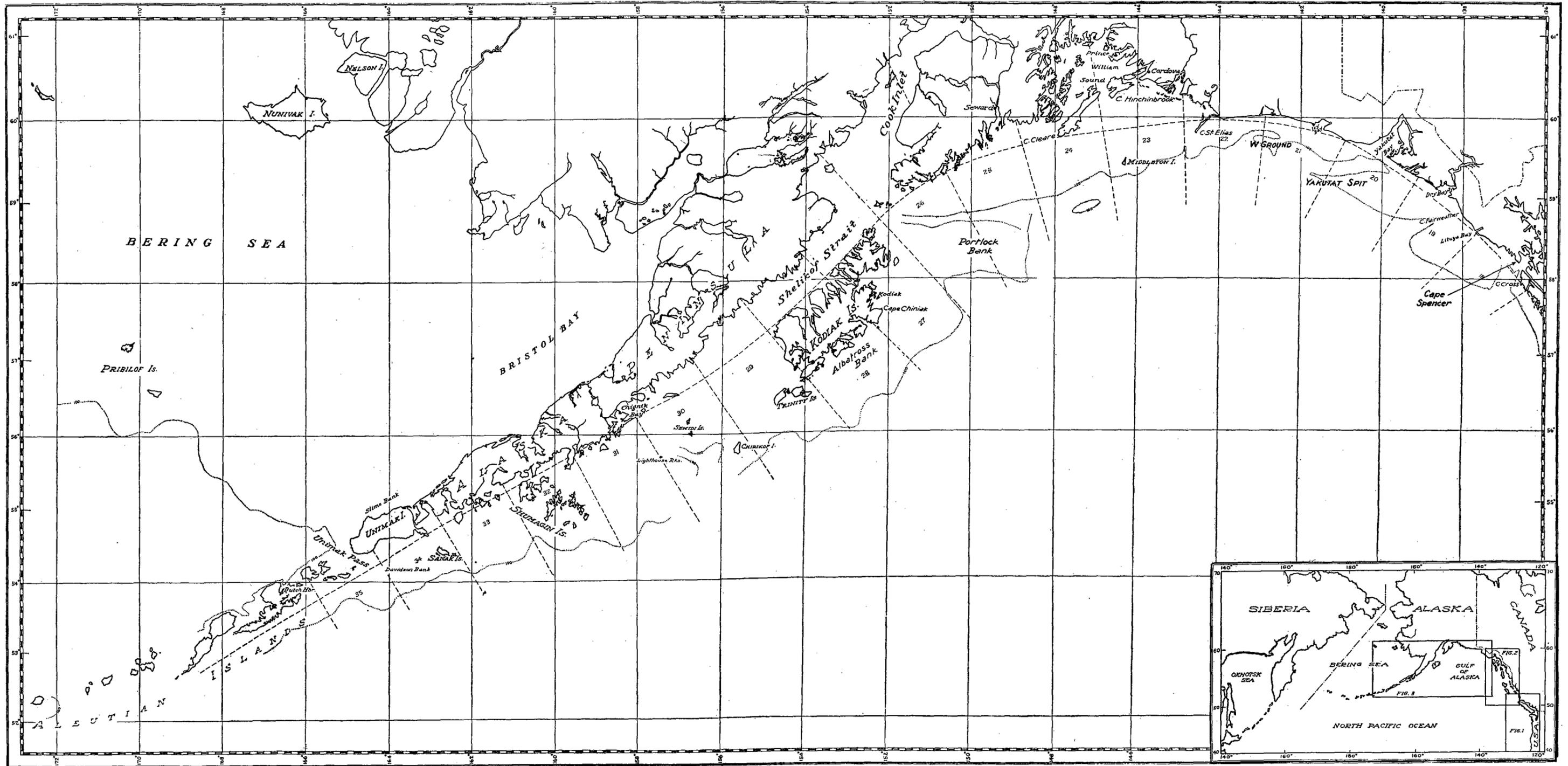


FIGURE 3.—Pacific Coast from Cape Spencer to the Aleutian Islands, showing the statistical areas by dotted lines. The insert shows the entire coast line divided into sections shown in Figures 1, 2, and 3.

BIOLOGICAL STATISTICS OF THE PACIFIC HALIBUT FISHERY

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ERRATA

- (1) Page 67, Table 17, column 9, the 13th item should read: 2,129,751.
- (2) Page 79, Table 22, column 2, the 9th item should read: 2,415.
- (3) Page 80, Table 23, column 6, the last item should read: 33,296.
- (4) Appendix A, Year 1921, area 19 to 23, June weight should read: 16,693.
- (5) Appendix B, Table 3, column 13, the 20th item should read: 902,596.

INTRODUCTION

The determination of the condition of the fishery implies comparison with the past. There is no existing standard with which the present condition can be contrasted, no method of measuring this condition except in a comparative way. The only standard available is that of the abundance which once existed or the yield which once was taken. Past records of these give the sole available clue to what the fishery should yield under ideal conditions. Furthermore, any system of observation which will serve to indicate the future condition of the banks must be continuous with this past record, and must, like it, be based upon those statistics which are natural to the industry and practical of collection. The records which exist have therefore become of the highest importance and have been gathered with the greatest care.

Preeminent among these records are those indicating the relative abundance of the fish as it changes throughout the years. And with this phase the present report has mainly to do. It is not to be expected that the results given will correspond to the experience of fishermen as to the profitable nature of the fishery at various times and places, since prices, weather, and class of fish taken enter into their calculations.

ACKNOWLEDGMENTS

The material for the present report has been log records kept by many captains of fishing vessels, small and large. Since these were collected in 1926 and subsequent years, most of them are old and could not have been obtained without the cooperation of the men concerned. The result is statistics which are unusually trustworthy because kept for personal use previous to the commencement of the work of the commission. It is impossible to mention each of these contributors by name. The long and continuous series of excellent log records kept by Captain Nesland from 1915 to date, first for the "Orient," then for the "Seattle," deserves special mention, although several others have kept equally detailed records for shorter times.

Nearly all present and previous members of the staff have had part in the collection and analysis of these logs. Those particularly concerned are: Miss Dorothy Myers, Miss Olivia Froula, Norman Freeman, Ernest Pegler, Olaf E. Eriksen, Richard Van Cleve, and Lloyd L. Bolton.

SUMMARY

The catch of halibut on the Pacific Coast is taken from a number of more or less distinct stocks, each of which has a different history and varies in its present condition. They are studied in this report by means of statistics of relative abundance, the yield per set of a unit of gear. A comparison has been made from year to year and the changes analyzed. The actual numbers on the banks cannot be counted directly, and even were it

possible, there would be little utility in so doing, as there are as yet no means of knowing what the maximum population should be. This must be determined by trial of the productiveness of the banks, and for practical purposes the maximum can be stated in terms of relative rather than in terms of absolute abundance. Our knowledge rests upon a system of sampling and must be stated in relative terms.

The commission has very complete statistics covering all other phases of the activity of the fleet. Using these, several measures of depletion, such as catch per fishing hour, have been tried and could be resorted to if necessary, but none prove as useful and adaptable as the yield per set of a unit of gear.

But the comparison from year to year must be an exact one. Were the gear to change in efficiency the relative abundance would err in corresponding degree. The first step in such a study has therefore been to determine the changes which have occurred in this gear and in the methods of the fishermen.

The gear used in the halibut fishery is well-adapted to statistical purposes. It is a long line set on the bottom, with short lines carrying the hooks at regular intervals. The catch from this gear is estimated closely by the amount of space filled each day in the fish hold. Records of this and of the gear used have been kept by a sufficient number of fishermen to give us reliable averages by area and month. These records have been kept by the captains for their own purposes and were made before they knew of our work.

The changes which may have affected the catch by the unit of gear used for comparison can be enumerated as those in length, distance between hooks, and weight or size of gear. By comparing great numbers of catches made in the same regions at the same times by the same method, it is found that these catches are proportionate to the length of the unit. It was found that the length has fallen in a ratio of 10 to 6 since 1906, and this change has been allowed for. Comparing the catches made by dory boats, which use hooks spaced nine feet apart, and those made by long-line boats, which use hooks spaced thirteen feet apart, it was found that the catch varied only as the length of the unit and that no difference existed. The weight or size of gear has been varied within recent years, and since a differing efficiency was known, records of such catches were omitted from the series used. The result of the study is to show that the records used are comparable throughout, as corrected to a basis of a 6-line, or 300 fathom unit, or "skate," using one set of this as a unit.

The results must be interpreted in the light of the constant shift of the fishery along the coast. The total catch has been maintained by an increase in the area exploited. Until 1911 the total of over 50 millions of pounds was taken within 500 or 600 miles north of Seattle, whereas in 1930 approximately the same came from over 2100 miles of coast. The older banks in Hecate

Strait have records extending back to 1906 or earlier. The newer banks in Bering Sea have been but recently touched. On this long coast there are at least two principal stocks of mature fish, one west of Cape Spencer, one south. The immature fish, migrating little, form numerous stocks, according to bank. Through this complex the fleet has progressed, lowering the abundance in each stock then going on to a new one, developing boats and machines to meet the needs of greater distances and smaller returns.

For study of the changes in these stocks the coast line has been divided into statistical areas, each containing 60 marine miles of the trend of the coast, and numbered from 0 at Cape Blanco in Oregon to 35 at Unimak Pass. The banks included in these areas are of varying extent, depending upon their extension seaward as well as upon the interior waters included. In the treatment of statistics for past years the areas are studied in groups, as only since 1926 are the records in sufficient number for each area.

The decline in areas 9 to 13 is dealt with first, as the oldest for which we have records. The yield per set of a unit of standard gear has fallen at a nearly even rate of 8 per cent yearly, from 272 pounds in 1906 to 111 in 1915, and to 48 in 1928. This is a fall of 81 per cent from 1906 to 1928. In areas 1 to 8, south of Cape Scott, records are not so abundant, but it is apparent that off the Oregon coast a great accumulated stock was quickly reduced, the catch falling from 308 to 134 pounds per skate in one year. The catches are now so low as to make the fishermen dependent upon cods¹ and other species. To the north of area 13, in Southeastern Alaska, the catch fell from 180 to 54 pounds per unit in the 14 years from 1914 to 1928, a decline of 70 per cent, as compared to a decline of 61 per cent in areas 9 to 13 in the same period. The decrease is at an even rate. It is apparent that the stocks south of Cape Spencer, area 18, have been depleted in similar fashion and without interruption. The banks near Prince Rupert, as might be expected, subsequent to the opening of the eastern markets through that port, soon fell to the same condition as the more southern banks in Hecate Strait or south.

The story of the banks beyond Cape Spencer, which is in area 18, is different. Areas 19 to 23, from Cape Spencer to Cape St. Elias, were first exploited in 1913. The catch per unit fell from a maximum of 320 pounds in 1915 to 126 pounds in 1918, rose again to nearly 180 pounds in 1921 and 1923, only to fall to new low levels of less than 80 pounds in 1925, and to 66 pounds in 1928. The fall from 1915 to 1928, in 13 years, was 79 per cent. Allowing for possible irregularities in the records, it is apparent that the depletion was halted between 1918 and 1921 or 1923, allowing an influx of newly mature fish from the untouched immatures of the western grounds. This halt was probably due to the decline in vessels fishing these banks, the number of steamers decreasing, while the number of schooners did not increase greatly until 1923 when the Diesel engine came into general use.

¹These are not true cods but the black cod or sable fish (*Anoplopoma*) one ling cod (*Ophiodon*) and the red cod (*Sebastes*). Of these there were landed at Seattle in 1927 from the areas 1 to 8 approximately three, one, and one-half millions of pounds, respectively, as compared to one and three-quarter millions of halibut.

The same characteristic trend of the abundance is shown on all the banks to the west of these areas. However, on areas 29 to 36, the first dependable annual average is in 1923. In that year the grounds were sufficiently well known to assure fair trials. Yet the catch per unit did not begin at a high level as it should have in a new stock of fish, but began at approximately the existing level of areas 19 to 28. From then on the rate of fall was much the same for the three groups of areas. In this there is evidence that the stock of mature fish from area 19 to area 36 is a freely migrating unit, corroborating the results of the marking experiments.

The catch per unit on the banks from Cape St. Elias to the west end of Kodiak Island declined 69 per cent from 1915 to 1928, and on those from Kodiak Island to Unalaska 50 per cent in the five years from 1923 to 1928 in spite of the inclusion of new grounds by the continued westward expansion. The decline is continuing.

As a result of this successive exploitation of the known banks, the total landed was kept at a high level, but not without greater effort. Considering the catch per unit of the fleet as a whole, without regard to bank of origin, it has decreased from 183 pounds in 1915 to 62 pounds in 1928. This fall has been at an increasingly rapid rate, and it would be of great interest to correlate this with the changing cost of production, if this could be done.

At the present time the abundance on the different banks increases progressively from the older southern to the newer western ones. This difference is not due to the period of exploitation but to the distance from the markets and the returns which are necessary to balance the greater cost of operation. In 1926, from 48 pounds per set in area 9, the catch increases to 60 pounds in area 18, and to over 80 in area 21 and beyond. It is variable, however, in areas 21 to 34, according to season of the fishery, character of banks, etc. But if this is taken into account, it is plain that the yield was in that year only slightly less on the nearer of these areas, 21 to 34, than on the distant. In 1927 the general levels were reduced, and in 1928 still more so. The decline seems to have been greatest on the newest banks, 19 to 36, since there the increasing efficiency of operation is of greatest significance. Every improvement in engines, fuel, speed, or otherwise, renders it possible to force abundance to a lower level. From an economic point of view, western and southern banks are equally depleted, and in that fishery in which efficiency counts most, the greater changes can be expected.

The western banks have a strong tendency to respond as a unit to exploitation, due to the fact that the mature stock is common to all, and due to the geographic situation of the banks. The somewhat greater abundance on the more removed of the western banks seems to be due to the stocks of immature residents, which are in different stages of depletion.

If it is true that economic factors determine the level of abundance which is maintained, it would seem that the fishery could be stabilized at any chosen level. The choice of the level would depend on its relative

profitableness. However, our records show that in no case on our coast has the fishery as yet been allowed to come to a permanent equilibrium.

The distribution of the intensity of the fishery, as derived from catch records, is of great interest. It is not complete for the three years in question, but is reasonably so for areas 13 to 36. The total catch per area, and the amount of gear used, are shown. It is greatest in area 13 and areas 25 and 26. The figures given will provide a basis for future comparison.

There have been some noticeable changes in the relative amounts of fishing done in the different regions from 1926 to 1928. There has been a considerable decrease between Dixon Entrance and Cape Spencer and a corresponding increase from Cape Spencer to Cape St. Elias. There has been a decrease between Portlock Bank and the Trinity Islands and an increase west of the Trinity Islands.

The seasonal abundance is compared with the seasonal intensity of the fishery, and it is shown that the declines in abundance previously discussed are true of all seasons and are not due to a shift of the fishery to less productive seasons.

Off the coasts of Oregon, Washington, and southern British Columbia, areas 1 to 8, the level of abundance is very low at all seasons, though slightly higher during the winter. The fishery has been conducted from spring to fall during recent years, and the closed season does not restrict fishing.

The fishery between the north end of Vancouver Island and Dixon Entrance, areas 9 to 13, is characterized by larger catches per unit of gear set in the winter and summer than in the spring and fall, there being two seasonal maxima. The summer maximum corresponds to the maximum abundance on the inner sheltered banks; the winter maximum to the maximum abundance on the outer coast banks where some mature fish school for spawning. The fishery on the inner banks predominates in total amount of gear set at all times of year but only to a slight degree in winter. Winter fishing in the region in general has declined and has been very little in the past 15 years because of the depletion of the spawning fish which school at those times. The present closed season does not curtail the fishery save to a slight extent on the outer banks in fall and spring. Since the inauguration of the closed season the seasonal maximum of intensity has shifted from July or August to June. No direct evidence as to the cause of this shift is at hand.

Off the banks of Southeastern Alaska, areas 14 to 18, the abundance is at a maximum in the winter months when the mature fish are schooled for spawning and at a lower level from spring to fall. Though the fishery has been primarily a summer one in recent years, a considerably higher proportion of winter fishing is done here than in the region to the south of it. Although in general the closed season has eliminated very little fishing, yet the stock on these grounds has received some slight direct

benefit from the closed season. The summer maximum of intensity has shifted to June since the inauguration of the closed season in 1924, as it has in areas 9 to 13.

The seasonal fluctuations in abundance of the stock between Cape Spencer and Cape St. Elias, areas 19 to 23, are similar to those on the outside coast in northern British Columbia and in southeastern Alaska, being a maximum during the winter schooling of spawners, and declining to a minimum in September. The winter maximum is more pronounced than is the case on southern banks due to the much greater proportion of mature fish in the stocks.

The abundance in each season shows the same decline. This clearly indicates that the decline in the average for the year is not due to the recent legal closure of a period of high yields, the major part of the spawning time.

The decline in this region was interrupted from 1919 to 1923 in all seasons of the year. There was even an increase in abundance during the winter seasons of these five years, an increase which can only be accounted for by a recuperation of the stock during a slackening of the fishery. This recuperation may have been an immigration of mature fish from less depleted banks, since the stock of mature migrants on the western banks has been shown to be a unit. But the fact of recuperation remains as an encouragement to regulation.

The closed season is more effective in eliminating winter fishing on the spawning grounds in this region than elsewhere. Prior to the closed season a very extensive winter fishery existed here. The effect of the closure, however, has been partly offset by increased intensity during the remainder of the spawning season.

Seasonal changes in abundance similar to those found on Yakutat and the W Ground occur in the region between Cape St. Elias and the west end of Kodiak Island, areas 24 to 28. Winter is the period of greatest abundance, and the seasonal changes in catch per skate-set are of the same type as on other sections of the outer coast in recent years, with a tendency toward a summer rise.

The fishery here is conducted principally from spring to fall and there has actually been an increase in the proportion of winter fishing done since the inauguration of the closed season which has had no direct limiting effect here. But the decline from year to year is present in all seasons and has not been noticeably affected by changes in the seasons of fishery.

In this region, as in the one to the eastward, the decline in abundance was halted following 1919 during all seasons. It would appear that this was most noticeable in the winter season here, too, though this cannot be definitely proved. The fact that it does occur corroborates the conclusion from tagging experiments that the mature stock west of Cape Spencer forms a freely migrating unit.

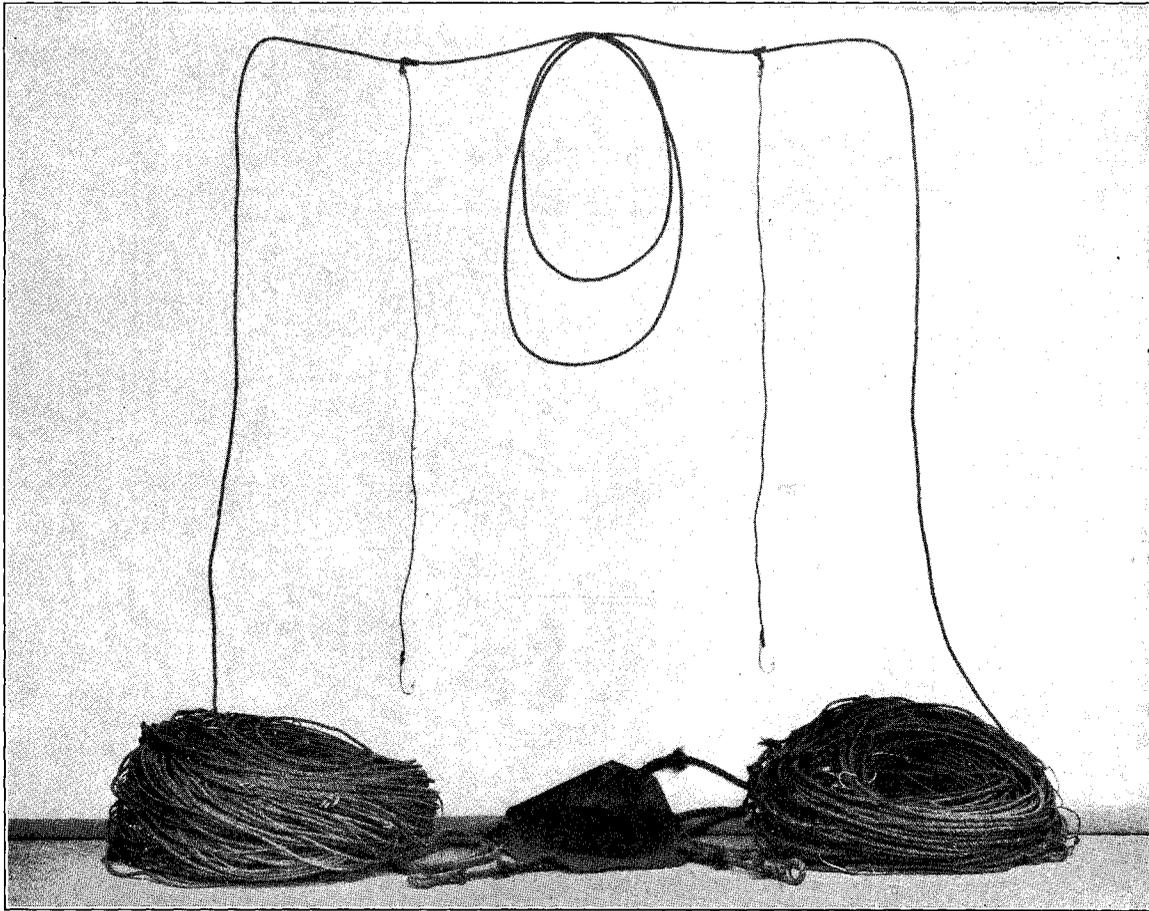


FIGURE 4.—Skate of gear, partly coiled, extended to show ganging and hook.

The abundance in the region west of Kodiak Island, areas 29 to 36, is highest in winter and lowest in summer, as in other western regions.

Fishing is most intense in the middle of summer. As the result of the westward shift of the fishery, a larger part of the year is now used, from May to August, rather than June to August. Practically no fishing has been done here in the winter season, and the closed season offers no direct protection to the stock.

METHODS OF THE FISHERY

The commercial halibut fishery on the Pacific Coast has always been a ground-line fishery. Hand-lining has been used by the natives and some whites, but this method has not contributed much to the catch. Trawling methods have been tried several times but were in each case abandoned due to lack of success. Halibut are bottom fish, as their appearance indicates. But they are nevertheless active and frequently are seen even near the surface. They are not confined to smooth, even bottom, but are often taken on broken bottom difficult to fish by any method except lines.

The fishing gear consists of a relatively heavy ground-line into which loops of light twine, known as "beckets," are set at regular intervals. To the beckets, short lines called "gangings" are attached. Each of these short branch lines is about 5 feet long and carries a single hook at the end. The intervals between gangings are 9 feet in dory gear, as most convenient for handling while fishing due to the position of the two men who use each dory. In fishing from the deck of the vessel, 13-foot gear is used as better adapted to the speed with which the gear comes in. The ground-line is built up by splicing together sections known as "lines," each of which is approximately 50 fathoms in length. For handling, the ground-line is coiled so as to make either two or three turns between hooks. It is divided into units known usually as "skates," but occasionally and at one time often, as "tubs." These units are of convenient size and weight, as is illustrated in Figure 4, for handling by one man. Each unit then is actually the amount of gear a man can readily lift around on deck while baiting, etc., and from the beginning of fishing on this coast each dory crew has had a definite number of skates to care for.

Halibut fishing is conducted in depths ranging from an occasional 15 to 200 or even 500 fathoms, usually between 45 and 150, depending upon the grounds and season. When gear is set overboard two or more skates are joined end to end, forming a "string." Each string is anchored at the ends and has a buoy line from each anchor to a buoy keg at the surface. Attached to each keg is a short line with a flag buoy, which floats freely upright. The anchors serve to keep the gear from drifting with the tide and becoming tangled or caught on rocks and debris on the bottom. The flag poles carry flags by day and lights by night, serving as markers to enable the fishermen to find the ends of the string. While the strings set by dories are usually short and of two to six skates, those set by

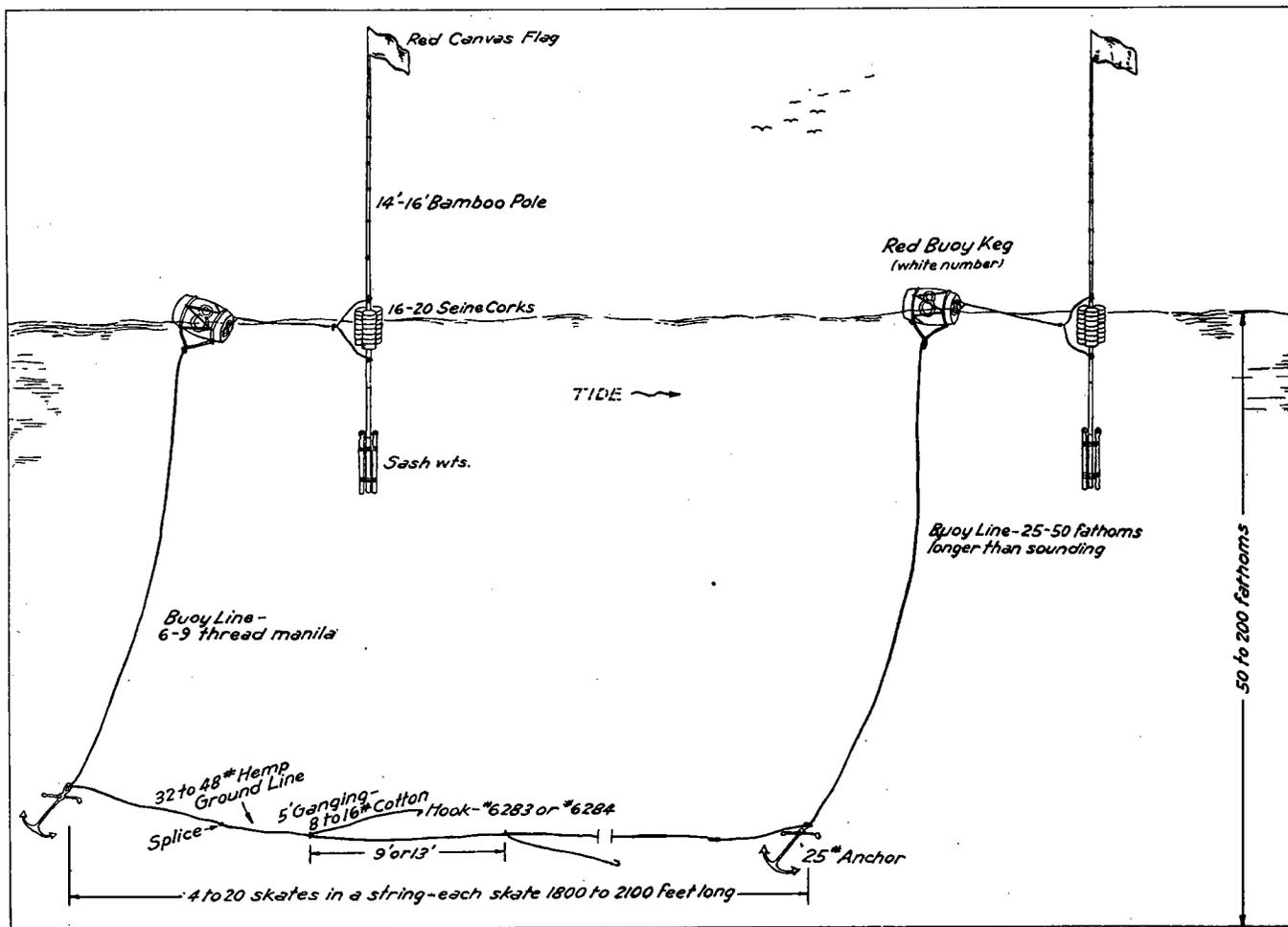


FIGURE 5.—Diagram of halibut gear as set.

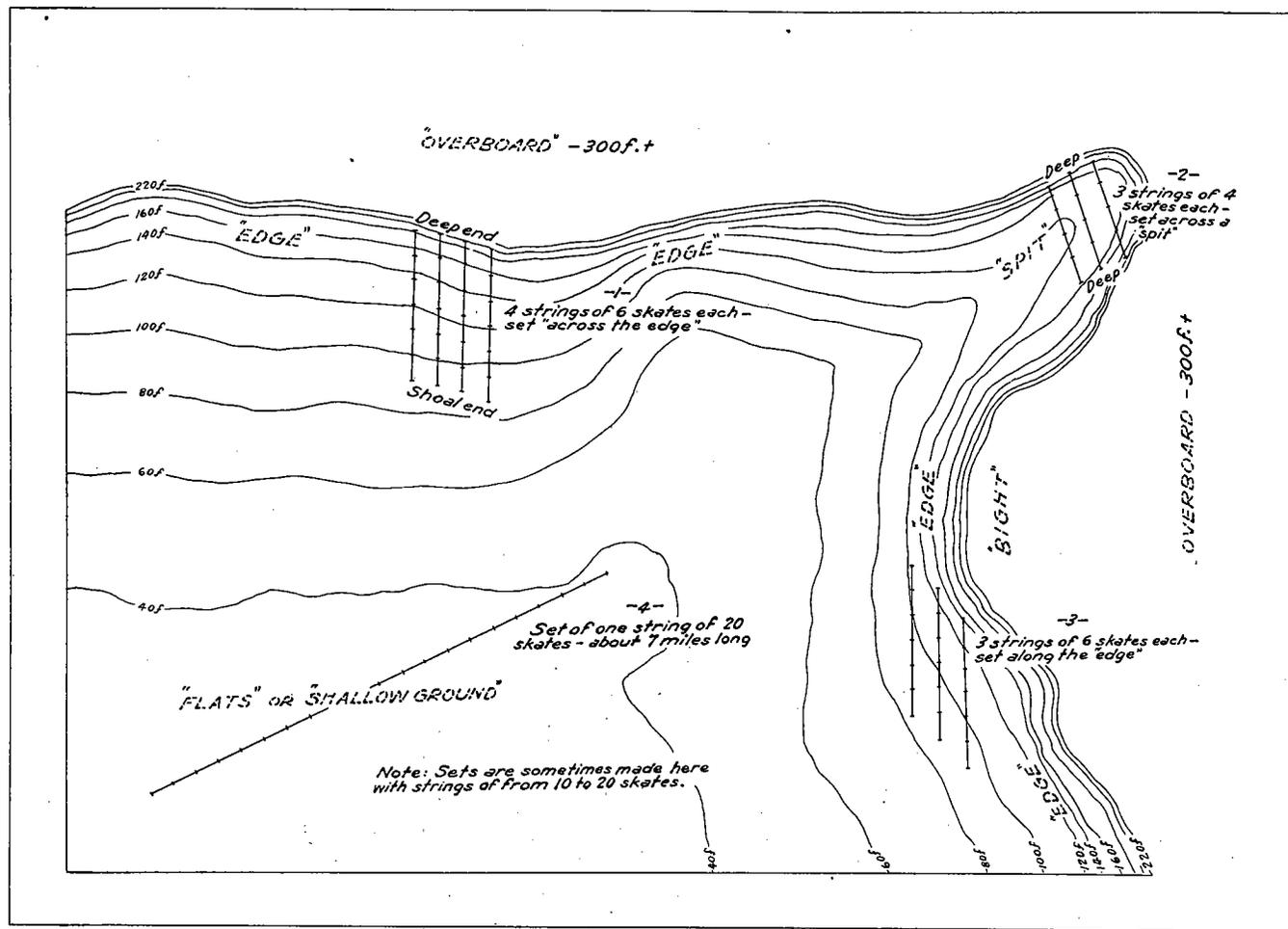


FIGURE 6.—Diagram of manner in which strings of halibut gear are set on different types of grounds, depth shown by contour lines at 20 fathom intervals out to 220 fathoms.

long-liners are frequently so long that they need to be anchored and buoyed in several places, not only to keep the gear from drifting, but also to provide a number of places from which the gear can be hauled in case the ground-line is caught on the bottom and "parted," as often happens on rocky ground. The appearance of a string in the water is shown diagrammatically in Figure 5. In Figure 6 are shown the ways in which a series of strings are set on various types of grounds.

From the standpoint of the method of fishing, there have been, and still are, two types of vessels operating on this coast. One of these is the dory boat, a distinctively American type of vessel, brought from Massachusetts, the first of them having rounded Cape Horn. The other is the long-line boat, which has been an importation from the North Sea, brought by the English skippers who fished out of Prince Rupert in 1914 or thereabouts. Some say that it is a natural development of the dory method, the fishing being done from the vessel itself rather than from small dories, while others hold that the method was developed independently.

The dories are small boats of a peculiarly seaworthy type and standard size. They are flat-bottomed, and so built as to be capable of being nested, or set one inside the other in stacks. To permit this, all gear inside is removable, and beackets are set in either end by which the dory can be lifted readily either in or outboard. The steamers carried dories to the number of 10 or 12, and at the present day vessels of 80 feet in length over all may carry as many as five or six. At one time the smaller vessels also carried these dories, one or two or three as the case might be, but they now use the long-line method only. The dories are put overboard on the banks, each with two men, and from them the gear is set and hauled. The amount of gear fished varies according to circumstances. Each dory may set from two to six skates in a string and may make two or occasionally more sets in a day.

The long-line boat, however, sets and hauls its gear directly from the vessel. Baiting, setting, and hauling may be carried on more continuously and in somewhat more convenient fashion, so that the handicap of hauling one line at a time is overcome. A long-line vessel carries less men and fishes less gear than a dory vessel of the same size, but fishes more gear per man on the average. The development of mechanical methods of hauling and setting, together with the greater comfort and safety enjoyed by the fishermen, are responsible for the growth and predominance of long-line fishing at the present time.

It is naturally of great interest to both fishermen and captains to know how much work has been done each day in each locality or on each trip. The effort is made to keep the number of skates fished per day as high as possible, and the desirability of the grounds is measured by the amount of fish taken relative to the amount of gear run. So too, easy or hard fishing is expressed in the number of skates it is possible to handle.

It thus comes about very naturally that whatever records are kept include the location and the numbers of skates fished each day.

The fish caught are stored on the deck in checkers, spaces partitioned off by vertical boards to check the sliding of the fish when the vessel rolls. At the end of the day's fishing or oftener, the catch which is lying on deck in the checkers of the vessel, whether long-line or dory, must be "dressed-down" and iced. In cleaning, the fishermen first remove the gills and viscera and then scrape and wash the body cavity to remove all traces of the kidney and associated blood vessels. The fish are then placed in the hold with their heads on. Here one or more fishermen fill the body cavity, called the "poke" by the fishermen, with crushed ice and pack the fish carefully, white side up, in this ice, stacking them in the "pens," partitioned-off spaces in the hold. By experience it is known how much fish each of the deck checkers or the pens will hold, and thereby it becomes possible to give for each day a rough measurement of the catch, and for each trip a close estimate of the total.

After some days of fishing, the number being dependent on the weather, the time since the first fish on board were caught, and the distance from the port where the fish are to be landed, the vessel leaves the fishing grounds for home. When the vessel arrives at its port of sale, the catch as previously estimated is listed with those of other boats on the halibut exchange and auctioned to the fish dealers. In Seattle, Prince Rupert, and Ketchikan, the names of the vessels and their estimated "trips" are listed on the blackboards in the exchanges and the bids of the various dealers are listed opposite, a price for each category of fish.

At the close of the exchange the highest bidder gets the trip, and the vessel ties up alongside the dealer's wharf to discharge. Here the fish are weighed as they are landed, but at the same time the fish are culled and sorted according to size; whether large, medium, or chicken; or to appearance, whether gray, soft, or scarred, etc.; and a different price is paid for the two different marketable grades, first or second, within which these different categories of fish are grouped, the first grade being the perfect mediums only. Sometimes, indeed very often, there is a third class of fish, mostly very small ones, which are counted "two for one." The real "culls," or fish unfit for sale, are supposed to be destroyed.

Whether the fish are sold on the exchange or direct to a dealer, there is a need for accurate information regarding the amount of the catch in the hold, since this amount is of importance to anyone considering purchase. Indeed, on the exchanges at present the hailed catch must be within a certain percentage of the actual weight or a penalty is incurred. The result is, naturally, a very considerable compulsion to produce accurate hails, resulting in a fairly exact habit of reckoning. This accuracy extends even to a knowledge of expected culls and to the grades expected on a basis of size.

It can thus be seen that there is in the manner of fishing, in the care of the catch, and in its sale, a method easily adapted to the requirements of a statistical system of observation of the fishery.

SOURCES OF STATISTICS

When the need of collecting statistics of abundance, or yield per unit of effort arose, it was found that there were several possible sources. The written records kept in the past were those of the custom houses at the ports of landing, those of sales on the fish exchanges, those of purchases by the wholesale fish dealers, and those by captains of the operations of their vessels. All of these contributed some fraction of information indispensable to a general picture of the activities of the fleet and the catches secured. Therefore all available records were collected.

These records were secured by inquiry, and all information was given voluntarily. Only in exceedingly rare instances were they refused, and since they were in each case originally compiled for the use of the individuals themselves, they can be regarded as reliable.

The Canadian and United States custom house records give the net tonnage and number of crew for each registered (5 or more tons net) vessel. The dates of clearance and entry, from which the length of trip can be derived, are also shown. Finally, the total amount of fish landed at the end of each trip is given in round numbers for the most recent years and some of the earlier ones, but rarely with sufficient accuracy for our purposes.

The records from the halibut exchanges, which are operated at the more important landing ports, have been kept in a more or less complete fashion by interested individuals. The commission now obtains these through its own agents. Where records are available, at least the name of the boat, total amount of catch as estimated by the captain, date of sale, prices, and purchaser are given. For some ports the approximate location fished and the amounts of the different classes of fish as estimated by the captain, are also included. The type of information contained is variable according to the port and the individual keeping the record. At no port do these records extend back for more than 14 years, and the earliest of these do not give the fishing locations. These banks of origin as thus recorded are not given detailed analysis in this publication, but only the more accurate log records will be used.

The amount of information contained in the dealers' records varies very considerably from dealer to dealer. Some dealers retain for each trip only the total weight bought. Some have the weights divided into first and second class, corresponding to the two prices usually paid. The majority, however, keep a record of the weights according to size, as mediums, chickens, and large. A few even classify the mediums according to condition as first class, second class, gray, etc. The earlier the year considered the fewer are the companies that have retained such records and the less is the detail given. Only for one port do dealers' records of any sort extend back for 14 years.

The records are listed in our files first as landings at the several ports day by day, showing the various vessels, for each its catch according to grades, the price at which sold, the approximate bank of origin, and the buyer. These are the landings hailed on the exchange, not the actual weights. From these records of hails the data as to each vessel are transferred to a single card for each calendar year, so that each vessel's activities are completely recorded as a unit. On these vessel cards for the last year are also recorded corrected banks of origin, as obtained by inquiry from the captain when landing at the principal ports. For a check a similar card holds the dealer's weights of landings by each such vessel. The dates of entry and clearance are obtained from the custom houses or the vessel's logs, and the length of voyage is calculated. Finally, the condensed records of the year by year activities of each vessel are combined on a single card covering its whole life, the crew employed, methods of fishing, etc.

Although considerable light of a general nature is thrown on the recent and present condition of the halibut banks by analysis of the custom house, exchange, and dealers' records described above, the analysis could not cover many years. It was not deemed advisable, therefore, to use them for the present purpose and they will be reported on at a later date. The desired information as to changes in abundance can be obtained more directly from written records of the actual fishing trials as kept by many of the captains. These records not only cover a greater period of time but are much more detailed and exact.

It is a matter of interest to the fishermen just how many skates of gear they "run daily," just as it would be to a cannery man to know how many cases were put up daily, since it is an indication of the relative efficiency. But the fishermen are interested in the catch taken, particularly in relation to the amount of gear fished, since thereby they are able to judge as to the relative abundance of fish, and to come back to the "spot" in question in the future if the fishing is good. Furthermore, the fishermen are interested in the amount of fish accumulating day by day in the hold, for it represents the approach to the end of the trip and the amount of returns they are to expect. The better the fisherman, the more keen his mind, the more likely he is to keep an accurate record in his log book of all these facts, for although such a record is not indispensable—indeed, some men prefer to keep the information in their heads—yet it forms a reference library, in a manner of speaking.

This is, naturally enough, of very great interest to us, for written records of the abundance are exactly what we are interested in, particularly when they are accompanied by accurate records of time and place as these log records are. The records are not all equally detailed, because in their very nature they represent the variable manners of men in carrying on their businesses.

Inquiry for log records of fishing operations has been made of practically every captain in the fleet and every company that has operated vessels of

its own. The fleet landing at Prince Rupert and Ketchikan, which contributes about two-thirds of the landings on the coast, was thoroughly canvassed by two men in 1926, and one man was stationed at Prince Rupert and Ketchikan in 1927 and 1928 for the specific purpose of collecting these logs, not merely for the current trips but also for past years, wherever the initial canvass failed to reach.

During 1929, the boats operating from Seattle were thoroughly canvassed for the first time, and much 1927 and 1928 data added. Naturally the last years, 1926, 1927, and 1928 are represented by the greatest and most complete number of records. In general, the earlier the year the fewer are the log records, but even for 1913 there are a few, perhaps enough records to give an approximate idea of the abundance of fish on the older banks then used. Fortunately, the log records of the steamers of the New England Fish Company and the Canadian Fishing Company were collected in 1915 and 1916 and the analysis of abundance made from these (Thompson, 1916) carries us back to 1906.

In Figure 7 is given a sample page of the log record of fishing as it is kept by fishing vessels.

ALTERNATIVE METHODS OF MEASURING DEPLETION

The statistics gathered by the commission are at present complete enough to furnish several alternative methods of determining the relative abundance from year to year. The length of voyage, the number of fishing days, the catch per dory or per man, and the catch per unit of gear are shown for a large number of boats.

The length of voyage reflects not merely the abundance, but also the increasing distance traversed on the way to new banks. Whether this distance remains constant or increases, it is a factor in the situation which does not reflect the change in abundance on any one bank, and the length of voyage as a whole does not increase proportionately with the decline in abundance.

Thompson (1916, p. S 78) has indicated clearly that the catch per hour of the voyage as a whole does not represent the decline in abundance. No further analysis of this will be attempted here.

But the amount of time spent fishing should increase with the decline if considered in relation to the catch made, were there no change in the manner of fishing. The change from dory fishing to long-line methods would imply less gear and smaller catches to the voyage. Any such improvement would mean fewer men and a different total catch, distorting seriously our measure of abundance, and necessitating two systems of comparison, according to the type of fishing done.

In the work by Thompson (1916) there was used a group of five steamers operating from a single port to the banks off British Columbia. Their

PILOT HOUSE LOG		FOR FISHING VESSELS.					
Vessel	Date	From	to		Trip No.		
DATE	TIME	NAME OF HEADLAND OR PLACE.	COMPASS.	DISTANCE BY LOC.	GEAR RUN.	ESTIMATE OF CATCH.	WEATHER.
Sept 9	11 ⁰⁰ pm	Left Seattle					
12		sounded 35 f					
13		off Goose Id. 35f	SW x W 1/2 W	21 mi	30	2000	
14						35 1500	
15						27 850	
15	5 ⁰⁰ pm	ran for C. St. James					
16		anchored in Carpenter Bay	SW	Gale			
17		anchored					
18		off Carpenter Bay	NNE	15 mi	16	200	
19		off Ramsey Id. 38f	NE 1/2 N	28 mi	33	2000	
20						40 2500	
21						37 1300	
22						16 750	
22	4 ³⁰ pm	Left for home				234 11100	
25	10 ³⁰ pm	Arrived Pier 8					
26		sold fish					
							med 7100 chix 4000

FIGURE 7.—Sample page of log book as kept by fishing vessels.



FIGURE 8.—Long-line fishing on Goose Island Ground.

methods varied little from year to year between 1906 and 1915, and his data show that the fishing time per voyage, considered in relation to the total catch, reflected approximately the same rapidity of decline in abundance as did the catch per unit of gear.

It is plain that the catch per voyage, divided by the fishing time in hours, will give the catch per hour's fishing. Then, if the number of skates run per hour is a constant, the catch per hour's fishing should reflect the decline in catch per unit of gear. In Figure 9 the catch per unit of gear as given by Thompson (1916) is compared with the rate of decline shown by this relation of the catch per voyage to the amount of fishing time.

Using Thompson's Tables 58 and 61, the average cargo for each month for each vessel has been divided by the number of fishing hours for the same voyages by the same vessels. The data are somewhat irregular in distribution, and as a result the difference between vessels has been ignored in making the comparison between years. But a somewhat truer value is obtained because the fishing time and the catch are for the same voyages in each calculation of the catch per hour's fishing. This gives the values in the second column of Table 1 and the upper curve in Figure 9.

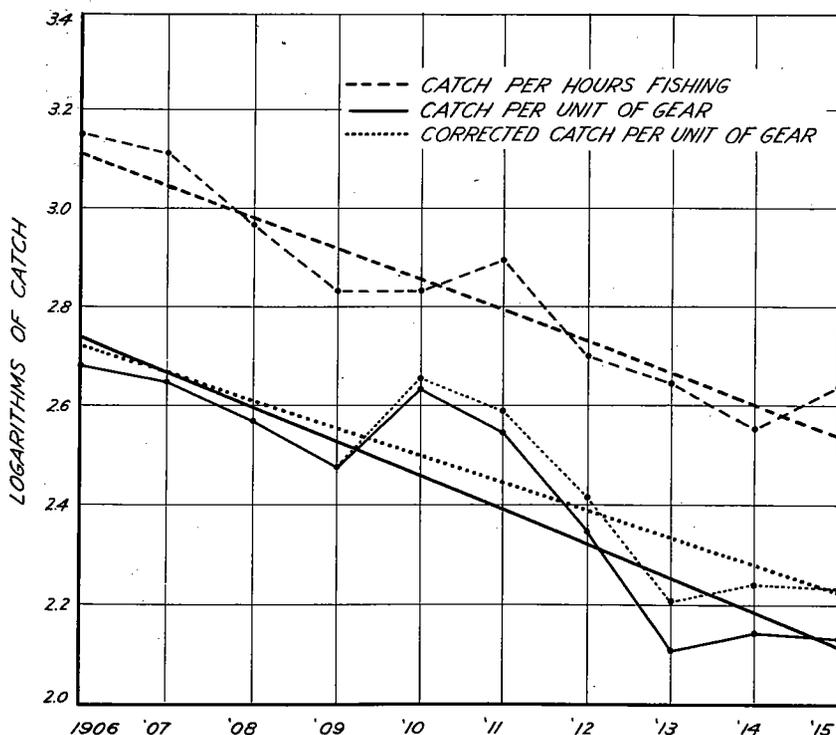


FIGURE 9.—Comparison of rates of decline in catch per hour's fishing, above, and in catch per unit set of gear, actual and corrected for changes in length, below. From Thompson, 1916, using selected data for British Columbia banks.

TABLE 1.—Comparison of catch per hour's fishing and catch per set of a unit of gear, 1906 to 1915. Areas 9 to 13.

Year	Calculated Catch per Hour's Fishing from Tables 58 and 61	Calculated Catch per Hour's Fishing from Tables 11 and 22	Catch per Unit of Gear
1906	1,409	1,365	487
1907	1,291	1,253	455
1908	934	1,051	379
1909	655	795	302
1910	682	611	428
1911	783	780	350
1912	502	554	221
1913	437	454	128
1914	358	355	139
1915	432	433	136

For contrast with this series the catch per unit of gear has been calculated directly from his Table 16 for those years and months which have records in his Tables 11, 16, and 22. This catch per unit has been used instead of the annual averages given or those used in Tables 10 or 11, because thus only comparable seasons and years are involved. It is given in the fourth column of Table 1. The corresponding catch per hour's fishing has also been calculated from his Tables 11 and 22. This is given in the third column of Table 1.

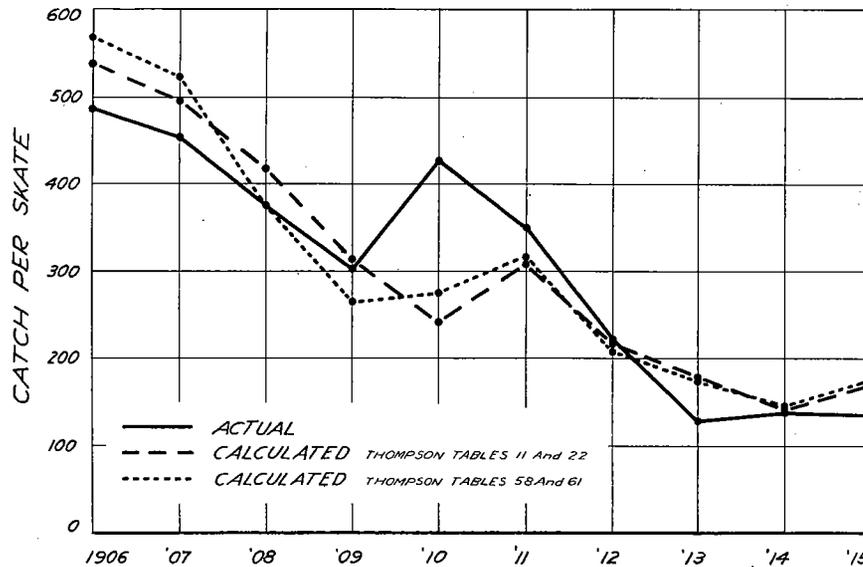


FIGURE 10.—Comparison of the decline in catch per skate-set as shown by actual catches and as calculated from catch per fishing hour on a basis of 2.53 skates run per hour. From Thompson, 1916, using selected data for British Columbia banks.

The logarithms of the values in the second and fourth columns are compared in Figure 9, each series being there fitted with a straight line to indicate the rate of fall. This is nearly the same for the catch per unit of gear as for the catch per hour's fishing. The values in the third column give nearly the same fall, with slightly greater irregularity. This fall amounts to 14 per cent per year for the catch per hour's fishing and 15 per cent for the catch per unit of gear.

For the sake of more direct graphical comparison, the catches per hours fishing have been divided by a constant in each case to bring them on the average to the level of the catch per unit of gear. The results are given in Figure 10. The principal discrepancy, in 1910, is due to the existence of data from but one vessel.

Given more complete and accurate data, as in recent years, the use of the two units should give strictly comparable results, as long as the fishing was done in the same way from year to year.

As we shall later show (p. 41), the length of the skate changed during the period 1906 to 1915 to eight-tenths of its length in the former year. For the purpose of showing the effect of this change, the graph for catch per skate in Figure 9 is accompanied by a dotted line to indicate the decline were this change in skate compensated for. In this particular instance the total decline overshadows the change, and the data are imperfect enough to render such accuracy in correction misleading.

It should, however, be borne closely in mind that the catch per hour's fishing is a valid unit of comparison only if the efficiency of the method of fishing has not changed appreciably, or in case it has changed, if this has been allowed for. If the same boat or boats are compared from year to year, it is therefore to be expected that these qualifying conditions could be met properly and that the catch per hour's fishing would prove a valid means of following changes in abundance. Under proper observation, this catch per hour's fishing is therefore an acceptable method of measuring depletion over a period which is not too prolonged.

It follows from this that where sufficient data are in hand to provide enough voyages to one particular bank or group of banks by vessels chosen for comparison as using standard methods, even the total length of voyage could be employed as a measure of abundance, since the time of passage could be dealt with as a constant. Thus despite the irregularity of the data given by Thompson in Table 13, the time spent in transit and lost because of bad weather during the summer declined on the average an inconsiderable amount, but 1 per cent from year to year, whereas it should have increased had the winter voyages to the newer banks been included. This was because during the summer the older banks only were frequented, and consequently by using the proper data for comparison the gross length of voyage became usable as a measure of depletion.

It therefore appears that in case regulatory measures were adopted, whereby clearance could be required for the particular groups of banks

frequented, this alternative method might be very useful. It would, however, entail much labor and is not adaptable to past years where data are scattered. Its consideration belongs to a report of the commission at present in manuscript, and no attempt will be made here to apply such a method.

A means of comparison but little different in essentials from the use of voyages by chosen vessels is that of reckoning the catch per dory, or per man. Unless the banks fished and the hours of fishing are taken into consideration, the results are of little use because of the tapping of new banks and the increasing efficiency of methods.

An instance of the use of the catch per dory is that in the Pacific Fisherman (Anonymous, 1916). First, the total number of dories in the Seattle fleet and then the catch per dory for 1904 and 1914 were calculated. The decrease was from 118,929 pounds to 95,597 pounds, about 20 per cent in 10 years, whereas on the older banks the fall in abundance was far greater, equalling about 8 per cent yearly or 60 per cent in 10 years (see p. 52). The conditions making the decrease less than that actually existent were enumerated as a very much longer fishing time, the use of power instead of sails, and of better equipment. No mention was made of the increased distance to the newer banks fished, nor of the greater abundance on these new banks.

No such detailed analysis of the vessels, their methods and the banks fished is necessary if the unit of gear fished by such vessels is shown to be comparable. It therefore becomes possible to utilize records furnished by all vessels in any given area, whether of single isolated trials or of many. The use of such a unit of gear becomes far less complicated and more flexible than that of catch per hour's fishing or per voyage. It renders even fishing records of early years usable regardless of whether the records for the vessel concerned are complete or not. The changes in this unit must, however, be carefully evaluated, something which can readily be done experimentally or from observation.

STANDARDIZATION OF THE UNIT OF GEAR

THE SKATE AS A UNIT OF FISHING EFFORT

It at once occurs to the investigator to test carefully whether the skate of gear used by the halibut fleet is suitable for use as a statistical unit. To answer the requirements of an ideal unit of fishing effort, the skate should remain unchanged from year to year, or, if it changes, it should be capable of correction to make the results comparable. This is a matter of great importance if the measure of abundance is to be made an accurate one.

That the skate of gear used by the halibut fleet has changed since the early years of the fishery was recognized in the earlier halibut investigation on this coast (Thompson, 1916, p. 72) and is well known to those engaged in or associated with the industry. Investigation shows, however, that

correction can be made for the changes that have taken place in the skate and that the skate is entirely suitable for use as a unit of fishing effort for statistical purposes.

The changes that have taken place in the skate and which might affect its efficiency have been of three kinds: First, a gradual reduction in the length of skate; second, an increase in the distance between hooks as the fleet shifted from dory fishing to long-line fishing; and third, the use in very recent years of lighter gear. These will be considered in turn to determine the effect of each.

There is, of course, a possibility that the unit of gear is allowed to lie on the bank for a longer or shorter time, thus varying what the fishermen call the "soak." This is a matter of individual judgment by the fishermen. It is, and always has been, carefully adjusted to give maximum returns on the particular bank concerned. For this reason, the possibility is slight that the time of soak has ever been allowed to vary so greatly as to disturb our comparative results for any area. The error thus caused can be but very small relative to the great differences due to depletion, and no correction is necessary.

RELATION OF LENGTH OF SKATE TO CATCH

When the necessity of determining the relative efficiency of skates of different lengths arose, consideration showed that care would be necessary in the selection of the data to be used for comparison if the results were to be reliable.

It was apparent that in this comparison there were possible sources of confusion if the difference between long-line and dory gear was involved in any way. In the first place the distance between hooks is not the same (p. 34) in the two kinds of gear. Moreover, the different manner in which they are fished tends to keep them on different types of ground. Therefore, comparison was necessarily limited to one type of gear, and as the long-line boats have used one length of skate practically exclusively from the beginning of that type of fishing to the present time, while the dory boats have used skates of several lengths, it was evident that only the dory boats provide the necessary material for comparison.

Dory fishing has been conducted principally in two well-separated regions of the coast, a southern one between the south end of Vancouver Island and Cape Ommaney, and a northern one extending from Cape Fairweather to the Shumagin Islands. Due to differences in the halibut population in the two regions and in the practices of the fishermen, the reliability of catch records from the two regions is quite different.

The southern fishery is maintained by fish that are young and small. While there is a minimum size limit, accepted by agreement between the dealers and fishermen, some dealers will buy smaller sizes at a reduced price. Some of the fishermen take advantage of this and retain all small

fish encountered and even concentrate on schools of very small fish, where the greater weight taken offsets the smaller price. Due to this practice the amount of catch is conditioned to a certain extent by the categories of fish taken, and one type of gear is more often used for small fish.

On the northern grounds the fish are much older and larger on the average than on the southern grounds. Relatively few fish below the generally accepted minimum size limit are caught or, if caught, are retained by the fishermen, as the trips to these grounds are long and small fish spoil quickly. Consequently the catch records from the northern grounds are uniform and suitable for the present purpose, while those from the southern grounds are not.

When the log records were examined to determine which lengths of skate, fished by dory boats in the northern area, could be compared best with the available data, it was found that only the skates of six and seven lines (of 50 fathoms) were sufficiently numerous in the same years to make the comparison worth while. Of the records available, those for the years 1920 to 1924 inclusive were selected as offering large amounts of fishing with both types of gear.

In making such an analysis it had to be borne in mind that the abundance of fish varies from one part of the coast to another at the same time, and also from one season to another in any one place. For this reason, fishing trials made at the same season and place had to be used for comparison. As the data were insufficient at any one place and time these fishing trials from different banks and seasons were necessarily combined. But care had to be taken, in combining the data, that equal amounts of the two kinds of gear were used from any one place at any one season, thus making certain that on the whole the two gears had equal opportunities for capture.

When the analysis was begun, it was at first attempted to pair only fishing trials involving equal numbers of the two kinds of skates in the same area during the same month. This was difficult because very frequently no trials of the same magnitude could be found. At other times a number of trials, showing greatly varying degrees of success, were available for pairing with one trial; and selection, with the danger of directional errors, was necessary. It was soon found that such large quantities of usable data were being wasted that insufficient would be obtained. An alternative method had to be adopted.

The total numbers of skates of 6 and 7-line gear were obtained for each area by months, together with the corresponding total catches. The numbers of skates obtained were, of course, always unequal, and adjustment was necessary to determine the catch which would have been made had the numbers been equal to that of the gear with the lesser representation. The catches by the two types of gear, as thus corrected, and for identical numbers of units of gear, were then included in the yearly totals. The great advantages of this method were that the maximum amount

of paired data was obtained and that all the comparable data added its weight to the results, helping to reduce the natural fluctuations.

Results of the analysis are given by years in Table 2. Of the 130,000 skate-sets of dory gear included in our records for the years used, only 11,000 of each type could be utilized. The ratios of the catches vary somewhat from year to year. Using 6.0 as the catch of the 6-line skates as a basis for comparison, the ratio of the catches by the 7-line gear varies from 6.54 to 7.42. Considering the natural variability of such catch data and the limited number of strictly comparable skates that could be included, the results are fairly regular. When the data for the six years are combined the ratio of the 6 to the 7-line gear is almost exactly 6 to 7. We must conclude, therefore, that the catch of skates, identical in every way except length, is proportional to the length.

TABLE 2.—Comparison of catch per skate by 6 and 7-line dory gear, year by year from 1920 to 1925. Trials matched by month and area.

Year	Sets of Each Type of Skate	Total Catch in Pounds		Ratio of Catches	
		6-line	7-line	6-line	7-line
1920	1,036	161,800	199,657	6.0	7.42
1921	1,729	289,650	315,800	6.0	6.54
1922	1,076	183,460	217,660	6.0	7.12
1923	1,303	227,500	264,800	6.0	6.96
1924	2,917	335,920	408,600	6.0	7.30
1925	2,796	355,790	394,024	6.0	6.64
1920-25	10,857	1,554,120	1,800,541	6.0	6.95

CHANGE IN LENGTH OF SKATE

The data used in the present report are a combination of two series of log records. The first of these, extending from 1902 to 1915, was collected by the senior author (1916) from the catch of five steamers owned and operated by the New England Fish Company and the Canadian Fishing Company. The second series, which was collected during the present investigation, is from many small and large boats of various characteristics, fishing from various ports subsequent to 1913.

The senior author was aware of the change in length of skate during the period covered by his data prior to 1915. This first decrease in length of skate, 10 lines to 8, came about 1910 with the necessity of fishing in the greater depths and on the outer coasts where the fish had then to be sought, due to the exhaustion of the older grounds. On Page 72 of his report (1916), the following statement regarding the unit of gear upon which his records were based was made, citing the testimony of one of the captains concerned:

"These skates are at present composed of 8 lines of 50 fathoms each, with hooks set about 32 to the line. At the inception of the present records, in 1902, the skate on the vessels which are here considered consisted of 10 lines, as stated by Captain Freeman in a letter dated June 18, 1916: 'The length of the skate now used on the halibut boats has been reduced from 10 lines to 8 lines of 50 fathoms each, or from a former length of 500 fathoms to 400. This change took place on the steamers about 7 years ago, but in recent years, since 1909, when deep-water fishing began, 8 lines have been used'."

Since the beginning of the present investigation, more exact information has been obtained regarding the gear on the boats whose logs were used in the cited publication and are used to supplement our own records. The late Captain Freeman, of the "Flamingo," made a more detailed statement in a letter dated September 2, 1927:

"... I may state that previous to 1899 various lines and hooks were tried, also with spaces of from 6 to 10 feet apart.

"The fishermen were paid so much per fish, and they had the impression the more hooks they set the larger would be their catch which, when fish were plenty, would be the case. About 1899, it was all dory fishing, and it was decided to make a uniform skate of gear of 10 lines with 9-foot space. Thirty-two pound lines were used. This was considered the most efficient to work. Nine feet gives the right space between the roller and the man aft coiling the gear and taking off the fish, for when a hook would be on the roller forward, the fish could be taken in aft. And thus gear could be handled faster when hauling by hand, as was formerly the case, no gurdy being used until about 1901. This standard obtained until after 1910, when other changes took place. Larger lines and 36 to 42-pound lines were used. But the dory fishing still kept 9-foot space on all our steamers. Some of the steamers changed from 10 to 8 lines a skate. I am not clear on the date, but feel almost positive it was in 1910. I was nearly a year later than the (captains of the) other steamers and it was in 1911 that we changed.

"About 1911 the fishermen decided, by the advice of their union, to all share equally in the catch. This at once reduced the catches as much less gear was run, and the amount of gear was reduced from eight 10-line skates to eight 8-line skates. In 1916 the gear was further reduced to six 8-line skates per dory, which was the lowest amount of gear we carried. Long-line was now in vogue, and we carried about 30 skates of six lines in addition to the dory gear. About half our long-line was hooked 9-foot space, the rest 11-foot. Gas boats not on company lay used different gear, some 6, 7, or 8 lines to a skate, as they thought most convenient."

Further light is thrown on the change of the New England Fish Company's steamers from 10 to 8-line skates by the statements of Captain Howard Giske, who was a fisherman on some of these boats at the time. The "Kingfisher" changed from 10 to 8-line skates during 1910 and the "Manhattan" was still using 10-line skates in 1912. And from the above letter of Captain Freeman the "Flamingo" changed in 1911, thus accounting for three of the five steamers used. 1909 must be considered as the last year in which the five steamers, whose logs were used, all carried 10-line

skates, and 1913 as the earliest year for all fishing to be with 8-line skates. It therefore seems reasonable that the change was distributed over several years and the best that can be done is to assume that this was gradual and between 1910 and 1912 inclusive. By such a method, the lengths used would become an average of 10 lines from 1902 to 1909, $9\frac{1}{2}$ lines in 1910, 9 lines in 1911, $8\frac{1}{2}$ lines in 1912, and 8 lines from 1913 to 1915. Such a gradation cannot be far from the truth, and only the transition period of three years is at all in question.

Determining the approximate average length of skate for each year in the catch records used in the previously cited publication is much easier than doing the same for the records from 1913 to the present, collected during the present investigation. The records to 1914 are all from steamers that fished dories, and only one change in length of skate is involved. The later records are from steamers using dories, or long-lining, or both, and from smaller vessels powered with internal combustion engines, but fishing in the same variety of ways. Skates of two lengths occur in all except two years, and skates of three lengths in all but five years.

In 1914 and 1915 the dory steamers were still fishing with 8-line skates. However, the skates used by some were composed of lines shorter than standard, making them about equal to a 7-line skate. Some of these continued dory fishing but soon changed to 6-line skates; others changed to long-line. One dory steamer that is still fishing, in later years changed to 7-line skates. The first long-lining steamers used skates of 7 short lines about equal in length to 6 standard lines. These soon changed to 6 standard lines, and others that began long-lining either part or full time used 6-line skates. Those that fished both long-line and dory usually carried 6-line skates for long-lining, but longer skates for dory fishing.

The types of vessels powered with internal combustion engines used mostly 7-line skates in 1915, the year when these first appear in our catch record. The dory boats, which were the most numerous, favored 7 lines, though a few used 8 or 6. Among the long-liners 6 lines predominated, with some 7 in use. Prior to 1920 changes were few, but about that time the dory boats began to change to long-line and adopt the long-line gear. Others continued dory fishing, but most of these gradually changed to the shorter skate. By 1928 very few boats were fishing with dories or using anything but 6-line skates.

From the above it is apparent that it would be difficult to make a definite statement from mere inspection of the records as to the length of skate which was used by the fleet from year to year. For this reason it was decided to determine by inquiry of the captains the type of gear used on all boats contributing to our catch records and when changes were made, and from this to determine the exact average length of the skate year by year for our records. The results of this analysis are given in Table 3. In this table each vessel is represented by the number of skate-sets it contributed to our records, according to its length of skate. It

will be seen that the change from an 8-line skate to a 6-line skate has been a gradual one.

TABLE 3.—Average length of skate, year by year.

Year	Number of Skate-sets Represented				Weighted Average Length
	8-line	7-line	6-line	Total	
1913	6,866	.....	.....	6,866	8.00
1914	9,951	.....	.....	9,951	8.00
1915	12,945	7,363	8,965	29,273	7.14
1916	4,130	4,200	14,002	22,332	6.56
1917	5,386	10,712	8,133	24,231	6.89
1918	4,256	8,415	8,990	21,661	6.78
1919	8,416	9,138	11,344	28,898	6.90
1920	1,051	9,824	23,037	33,912	6.35
1921	.....	16,922	29,661	46,583	6.36
1922	202	16,437	33,677	50,316	6.33
1923	314	23,309	41,322	64,945	6.37
1924	2,694	21,338	61,975	86,007	6.31
1925	2,979	30,220	78,785	111,984	6.32
1926	598	44,254	262,742	307,594	6.15
1927	.....	10,857	207,195	218,052	6.05
1928	.....	29,138	331,662	360,800	6.08

RELATION OF DISTANCE BETWEEN HOOKS TO CATCH

From the standpoint of distance between hooks, two types of gear have been and still are used. One of these, dory gear, is used by the dory boats, while the other, long-line gear, is fished by the long-liners, although at times a vessel may alternate types of gear.

The dory boats have always used lines on which the hooks are spaced 9 feet apart, because that is the right distance for efficient work in the dory, as the man in the bow, hauling the line, can hold one ganging and hook while the man in the stern is taking the fish off the next. The long-liners usually use gear with the hooks 13 feet apart, because the men handling the gear on deck must have more space to "shack" the fish off the hooks as the line comes over the side.

Prior to 1914, practically all commercial halibut fishing was done from dories, using dory gear. At that time, however, long-lining was introduced. The majority of new boats built since have done nothing but long-lining, and the old dory boats have gradually changed to that method. The change from dory to long-line fishing is well illustrated in Table 4, in which the actual and percentage amounts of the two types of gear, represented in each year's log records from 1913 to 1928, is given. In 1928 a very small part of the commercial catch was the result of dory fishing. The necessity of determining the relative efficiency of long-line and dory gear is therefore very apparent, if comparison is to be made between the records of abundance for early and late years. The trend is reliable and if the relative efficiency of the two types is known, is all that is required for the utilization of the log records at hand, since it applies directly to those records and not to the whole fleet.

TABLE 4.—Percentage of dory and long-line gear in the log records collected by the International Fisheries Commission for years from 1913 to 1928.

Year	Number of Skates			Percentage of Total	
	Dory	Long-line	Total	Dory	Long-line
1913	6,866	.....	6,866	100.0	.....
1914	9,953	.....	9,953	100.0	.....
1915	21,500	7,774	29,274	73.4	26.6
1916	8,289	14,043	22,332	37.1	62.9
1917	18,085	7,109	25,194	71.8	28.2
1918	12,610	10,206	22,816	55.3	44.7
1919	17,635	11,264	28,899	61.0	39.0
1920	19,631	14,329	33,960	57.8	42.2
1921	30,539	14,251	44,790	68.2	31.8
1922	21,100	29,132	50,232	42.0	58.0
1923	28,336	36,466	64,802	43.7	56.3
1924	34,777	52,907	87,684	39.7	60.3
1925	40,291	72,314	112,605	35.8	64.2
1926	42,435	265,159	307,594	13.8	86.2
1927	16,596	201,456	218,052	7.6	92.4
1928	25,108	335,692	360,800	7.0	93.0

But it must be remembered that the annual percentage of all gear which was used by dory vessels cannot be considered representative of the whole fleet, except for the last three years, 1926, 1927, and 1928, in which the logs from large numbers of boats are included. In general, the other years tend to show a larger proportion of dory gear than was actually in use, due to the fact that a greater percentage of the large than of the small boats have kept good records of their fishing. The majority of the smaller boats adopted long-line years ago while the majority of the largest boats changed only in the last few years.

The relative amount of fish taken by the two types of gear is shown in Table 5 according to statistical areas for 1926, 1927, and 1928. In 1926, of the catch for which we have log records, 19 per cent was taken on dory gear, in 1927 about 8 per cent. A sharp decline in the importance of dory fishing in these years is clearly indicated, while the areas in which it was carried on changed as markedly. These facts must be considered in making a comparison of the relative efficiency of dory and long-line gear.

The data are shown graphically in Figure 11, in which the amounts caught by dory fishing in each statistical area are shown by the height of the columns. A relatively small amount was taken in 1926 in areas 9 to 13 inclusive, from the north end of Vancouver Island to Dixon Entrance. Dories were also used to some extent in area 15, where small fish were taken off Cape Addington and Timbered Islet in Southeastern Alaska. But the greater part of the fishing with dories occurred in the western region, statistical areas 24 to 36, including Portlock Bank, Cook Inlet, Albatross Bank, and those banks around Chirikof Island and the Semidi and Shumagin Islands.

TABLE 5.—Comparison of weights caught by dory and long-line vessels for 1926, 1927, and 1928, arranged by area.

Area	1926			1927			1928		
	Long-line	Dory	Total	Long-line	Dory	Total	Long-line	Dory	Total
1	5,392	-----	5,392	112	-----	112	11,610	7,500	19,110
2	-----	-----	-----	60	-----	60	19,149	2,600	21,749
3	14,100	-----	14,100	42,955	-----	42,955	51,780	-----	51,780
4	31,800	-----	31,800	1,500	-----	1,500	1,325	-----	1,325
5	72,704	-----	72,704	7,568	-----	7,568	40,380	-----	40,380
6	18,495	-----	18,495	30,740	-----	30,740	182,178	12,000	194,178
7	63,505	-----	63,505	17,673	-----	17,673	48,720	-----	48,720
8	2,900	-----	2,900	5,800	-----	5,800	106,709	-----	106,709
9	172,530	36,700	209,230	59,393	159,000	218,393	284,455	244,650	529,105
10	352,246	137,400	489,646	256,871	127,500	384,371	432,046	470,550	902,596
11	1,000,718	11,400	1,012,118	636,644	94,050	730,694	806,573	149,400	955,973
12	875,705	1,000	876,705	464,468	28,250	492,718	772,455	14,600	787,055
13	1,811,165	56,305	1,867,470	968,474	13,500	981,974	2,129,751	-----	2,129,751
14	613,450	-----	613,450	243,213	5,000	248,213	297,104	11,500	308,604
15	797,350	452,500	1,249,850	386,764	320,500	707,264	345,581	87,200	432,781
16	783,247	-----	783,247	260,617	-----	260,617	543,828	2,000	545,828
17	272,019	-----	272,019	171,367	-----	171,367	221,750	11,000	232,750
18	439,370	-----	439,370	247,634	-----	247,634	495,308	-----	495,308
19	395,250	16,600	411,850	558,484	-----	558,484	734,670	-----	734,670
20	962,035	-----	962,035	513,684	-----	513,684	996,779	12,500	1,009,279
21	475,650	14,200	489,850	795,149	-----	795,149	988,154	2,000	990,154
22	252,000	-----	252,000	334,400	-----	334,400	474,909	-----	474,909
23	226,700	5,000	231,700	337,893	-----	337,893	562,750	-----	562,750
24	638,609	176,800	815,409	605,429	-----	605,429	886,210	13,500	899,710
25	2,037,403	564,650	2,602,053	1,373,013	25,500	1,398,513	2,309,714	23,500	2,333,214
26	2,048,940	1,276,500	3,325,440	884,599	492,500	1,377,099	1,471,067	575,100	2,046,167
27	996,025	278,900	1,274,925	922,882	50,500	973,382	1,338,522	34,250	1,372,772
28	995,700	350,500	1,346,200	1,046,545	63,000	1,109,545	1,366,340	34,850	1,401,190
29	1,268,585	582,800	1,851,385	901,359	21,500	922,859	943,229	8,000	951,229
30	657,034	171,500	828,534	1,292,011	-----	1,292,011	926,748	41,100	967,848
31	378,535	77,000	455,535	134,216	66,000	200,216	300,617	5,000	305,617
32	118,900	86,000	204,900	513,716	66,000	579,716	499,417	-----	499,417
33	84,000	63,450	147,450	8,750	-----	8,750	142,600	-----	142,600
34	-----	4,750	4,750	8,750	-----	8,750	100	21,000	21,100
35	-----	-----	-----	-----	-----	-----	500	-----	500
36	-----	-----	-----	-----	-----	-----	26,300	-----	26,300
Total	18,862,112	4,363,955	23,226,067	14,032,733	1,618,800	15,651,533	20,759,328	1,783,800	22,543,128
Percent- age	81.2	18.8	-----	89.7	10.3	-----	92.1	7.9	-----

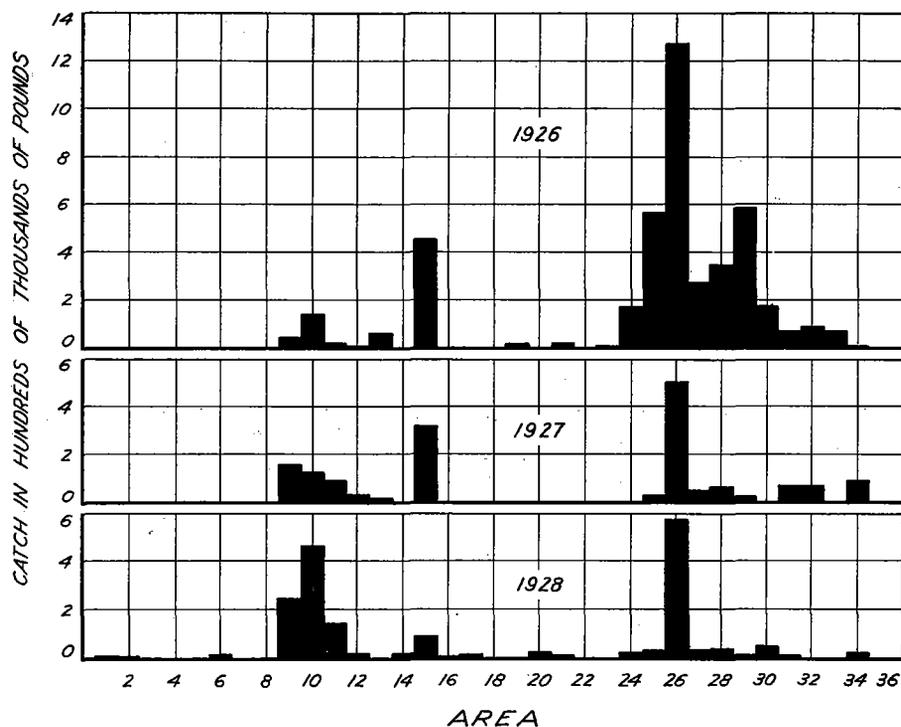


FIGURE 11.—Total weights caught according to area in 1926, 1927, and 1928 by dory boats.

This concentration of dory fishing in the western region was natural since the boats that still used the dories were all large vessels, depending mostly on the western grounds for their fishing. A few of these large boats moved to the southern grounds and fished for the Seattle markets in the summer months and did all the dory fishing recorded for the southern banks (areas 9 to 13), depending on the western grounds for their spring and fall fishing.

The general practice now is to fish long-line during the early spring and late fall months, as gear can be handled by long-line in weather that is so stormy as to stop dory fishing. After the stormy season is past, a few take on their dories and fish in that way until the winter season approaches. This is well illustrated by Table 6, giving the number of skate-sets of gear by United States dory boats landing at Prince Rupert in 1926. The data are arranged by months and areas. The numbers of skates fished in the summer months are much higher than in the spring and fall.

TABLE 6.—Number¹ of skate-sets of dory gear by United States vessels in 1926, according to month and area.

Area	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Total
9	91	40	.....	.....	.....	.....	.....	.....	240	.....	371
10	55	1,885	.....	.....	.....	182	.....	.....	50	160	2,332
11	27	83	.....	.....	.....	.....	.....	.....	.....	.....	110
12	.....	.....	.....	.....	12	.....	.....	.....	.....	.....	12
13	.....	72	180	153	.....	.....	.....	.....	.....	.....	405
14	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
15	.....	.....	572	348	850	1,289	940	610	.....	.....	4,609
16	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
17	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
18	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
19	60	.....	245	.....	.....	.....	.....	.....	.....	.....	305
20	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
21	35	.....	.....	.....	.....	.....	.....	56	.....	65	156
22	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
23	.....	18	90	.....	.....	.....	.....	56	.....	.....	164
24	100	298	239	60	.....	.....	144	455	416	119	1,831
25	506	1,117	960	769	635	573	210	15	168	.....	4,953
26	890	553	400	1,813	1,582	884	2,351	2,122	313	.....	10,908
27	370	104	756	78	24	72	.....	774	260	.....	2,438
28	147	132	838	432	261	564	1,388	264	525	.....	4,551
29	.....	318	319	726	1,767	726	1,381	264	.....	.....	5,501
30	.....	.....	28	4	1,019	.....	564	.....	.....	.....	1,615
31	.....	216	27	216	.....	.....	297	.....	.....	.....	756
32	.....	.....	.....	501	152	234	.....	.....	.....	.....	887
33	.....	.....	.....	309	.....	159	.....	.....	.....	.....	468
34	.....	.....	.....	.....	.....	63	.....	.....	.....	.....	63
Total	2,281	4,836	4,654	5,409	6,302	4,746	7,275	4,616	1,972	344	42,435

¹Not corrected for length of skate.TABLE 7.—Number¹ of skate-sets of dory gear by United States vessels in 1927, according to month and area.

Area	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Total
9	510	499½	785	267	280	310	2,651½
10	285	1,182½	128	451	130	40	2,216½
11	304	403	.....	.....	.....	707
12	195	123	.....	.....	.....	318
13	175	.....	.....	.....	.....	.....	175
14	30	30	.....	.....	.....	.....	60
15	350	874	1,400	455	.....	.....	.....	.....	3,079
16
17
18
19
20
21
22
23
24
25	22	.....	.....	132	.....	.....	.....	.....	.....	154
26	22	.....	.....	132	1,782	1,012	341	.....	.....	3,289
27	324½	93½	.....	.....	.....	387	.....	.....	805
28	324½	93½	.....	.....	.....	621	.....	.....	1,039
29	342	.....	.....	342
30
31	544½	.....	.....	.....	.....	.....	.....	544½
32	544½	.....	.....	.....	.....	.....	.....	544½
33
34	671	.....	.....	.....	.....	.....	671
Total	44	999	2,150	3,335	4,448	2,451	2,409	410	350	16,596

¹Not corrected for length of skate.

TABLE 8.—Number¹ of skate-sets of dory gear by United States vessels in 1928, according to month and area.

Area	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Total
1	320	.....	.....	320
2	80	170	.....	.....	250
3
4
5
6	200	.....	.....	.....	.....	.....	.....	200
7
8
9	130	120	305	250	355	478	715	987½	1,049	90	4,479½
10	170	140	245	744	1,810	1,394	1,860	782½	45	.....	7,190½
11	626	1,340	250	.....	.....	.....	2,216
12	15	170	.....	.....	.....	.....	185
13
14	82½	25	20	.....	.....	.....	.....	127½
15	672½	180	60	.....	.....	.....	.....	912½
16	30	.....	.....	.....	.....	.....	30
17	93	.....	.....	.....	.....	.....	93
18
19
20	108	.....	.....	108
21	57	.....	.....	57
22
23
24	88	.....	.....	.....	.....	.....	.....	.....	.....	88
25	88	.....	.....	.....	24	.....	10	95	.....	217
26	88	.....	847	1,844	1,394	1,715	462	95	.....	6,445
27	192	81	129	148	.....	.....	550
28	129	15	480	.....	.....	624
29	126	.....	.....	.....	.....	.....	126
30	132	471	.....	.....	.....	.....	603
31	66	.....	.....	.....	.....	66
32
33
34	220	.....	.....	.....	.....	.....	.....	220
Total	300	524	550	3,016	5,428	5,627	4,764	3,525	1,284	90	25,108

¹Not corrected for length of skate.

Something of the habits of these large dory vessels is also shown by Table 6. In February, the few that were operating centered around Portlock Bank (areas 25 and 26), this being the nearest shoal bank offering fish in sufficient abundance to warrant exploitation. As the weather improved some went farther west and by the middle of summer were beyond Shumagin Islands (area 32). The majority, however, remained in the vicinity of Kodiak Island. As the season advanced and unsettled weather approached, the boats gradually withdrew to the eastward and by October were all in the vicinity of Portlock again.

The corresponding tables for 1927 and 1928 show the recent very marked changes in the use of dory gear. In both years the amount of dory gear fished west of the Gulf of Alaska in areas 24 to 33 has fallen and has become still more highly seasonal. That fished south of area 18, or Cape Spencer, shows little decline through 1928. The dory fishing in area 15 varies sharply from year to year with the market for very small fish. It is evident that if the tendencies of recent years continue, dory fishing will no longer be carried on except where there are special advantages, as in shoal water for dense schools of small fish.

Statements of the fishermen as to the relative efficiency of the two types of gear are swayed by their individual training. It is the judgment of experienced fishermen and of our own staff that a halibut, if not caught when it takes its first bait, follows up the gear and takes other baits until it is caught. Moreover, it does not seem necessary that the bait should be placed in the immediate neighborhood of a halibut to attract it. This conclusion is based on the finding of many more than one bait in the stomachs of many fish, and upon the well-recognized fact that parallel lines of gear fish best when set somewhere near a skate-length apart. The ground covered, rather than the number of hooks, becomes the more important factor. Where fish are scattered, there is no reason why each halibut would not be tempted by more than a sufficient number of hooks even when 13-foot gear is in use, but where fish are schooling densely it would seem that 9-foot gear should have the advantage because more fish would be available than there were hooks for. On the other hand the long-line gear is better adapted to prospecting, since the sets can be distributed more widely and less need be put out the first trial. The advantages and disadvantages may, indeed, be many. There can be but one conclusive manner of reaching a decision as to relative efficiency—that by actual comparison of the catches made.

For purposes of comparison the 1926 data are used because both types of gear are in that year best represented in our records in spite of the low proportion of dory gear.

In Tables 9 and 10 comparison is made of the efficiency of dory and long-line gear in 1926, for areas 24 to 30 inclusive, that part of the coast where the fishery concentrates on spawning schools in early and late winter, where dory gear should have the advantage if at all. Long-line skates were all of 6 lines (1 line equals 50 fathoms) but the dory gear was mixed, some boats using 6 and some 7-line skates. When analyzed for length

TABLE 9.—Comparison by areas of the relative efficiency of dory and long-line gear in areas 24 to 30, in 1926.

Area	Dory				Long-line		
	Skate-sets	Pounds	Average Per Set	Corrected Average	Skate-sets	Pounds	Average per Set
24	1,831	176,800	96.6	88.6	7,326	638,609	87.2
25	4,953	564,650	114.0	104.6	20,107	2,037,403	101.3
26	10,908	1,276,500	117.0	107.3	18,525	2,048,940	110.6
27	2,438	278,900	114.4	105.0	11,000	996,025	90.5
28	4,551	350,500	77.0	70.0	11,522	995,700	86.4
29	5,501	582,800	105.9	97.2	11,896	1,268,585	106.6
30	1,615	171,500	106.2	97.4	6,351	657,034	103.5
Total	31,797	3,401,650	107.0	98.2	86,727	8,642,296	99.6

length of skate on the basis of the type of gear used by each boat and the number from each vessel represented, it was found that 56 per cent of the dory skates fished in these areas had 7 lines. The dory skates on the average, therefore, were 1.09 times as long as the long-line skates. To make comparison valid the dory catch was corrected for the difference in length of skate. In Table 9 the dory and long-line catches for the whole year are compared by areas, in Table 10 by seasons.

TABLE 10.—*Comparison by seasons of the relative efficiency of dory and long-line gear in areas 24 to 30 in 1926.*

Month	Dory				Long-line		
	Skate-sets	Pounds	Average Per Set	Corrected Average	Skate-sets	Pounds	Average per Set
Feb.	2,013	348,200	173.0	158.7	6,412	1,012,945	158.0
Mar.	2,522	322,950	128.1	117.2	9,936	1,057,927	106.5
Apr.	3,540	329,800	93.2	85.5	12,446	1,241,600	100.0
May	3,882	319,100	82.2	75.4	9,846	888,275	90.2
June	5,288	553,600	104.7	96.1	8,333	867,384	104.1
July	2,819	339,000	120.3	110.4	7,341	689,135	93.9
Aug.	6,038	680,500	112.7	103.4	13,366	1,158,380	86.7
Sept.	3,894	358,600	92.1	84.5	11,695	1,079,380	92.3
Oct.	1,682	135,200	80.4	73.8	6,069	524,450	86.4
Nov.	119	14,700	123.5	113.3	1,283	122,400	95.4
Total	31,797	3,401,650	107.0	98.2	86,727	8,641,876	99.6

In Table 9 the average catch per skate of dory gear for areas 24 to 30 inclusive is shown at the foot of the fourth column as 107 pounds. This, when corrected for the length of the skate, gave a catch of 98.2 pounds for a dory skate, as compared to 99.6 pounds for the long-line gear. This shows the greater catch for the gear with the fewer hooks, the opposite of what might be expected. But the slight difference shown is well within what would be expected through chance alone.

The catches, when considered by separate areas, are in nearly as close agreement. The seasonal analysis, showing greater variability from month to month, fails to indicate any definite difference even in winter, when the fish are schooling densely and hence might be expected to favor the greater number of hooks.

It is difficult to make any analysis of why the catch does not differ more. It is certain, however, that if dory gear has an advantage in any place or season, due to the hooks being 9 instead of 13 feet apart, it is lost otherwise.

To conclude, it is evident that the skate of halibut gear, if corrected for length, may be used as a unit of fishing effort without any consideration as to whether the hooks were 9 or 13 feet apart, for the error involved

is either due to chance or is minute in comparison to the changes in yield which are found over periods of years. Accepting this error as not due to chance, the change from dory to long-line if compressed within a period of one year would involve an error of about one and a half per cent. But this change has been distributed over a period of 15 years, leaving the average annual change as one-tenth of a per cent. Yet, in contrast, the initial catch on the banks in question was some 300 per cent of that for the final year.

RELATION OF WEIGHT OR SIZE OF GEAR TO CATCH

There yet remains to be considered a recent modification of the gear which has altered the efficiency of the skate used by some boats in certain parts of the coast.

About the time the investigations of the commission began, in 1925, complaint was made by a number of fishermen to the International Fisheries Commission that some boats were using a "fine gear" that was unduly destructive of "baby chix." It was claimed that a larger percentage of the small fish took the smaller hooks used on such gear than took the larger hooks used on the standard gear. It was desired that such gear should be prohibited.

Inquiry showed that the so-called fine gear consisted of lighter ground lines, lighter gangings, and smaller hooks than were generally used. The ground-lines ranged from 28 pounds to perhaps as heavy as 40 pounds. The gangings were from 10 to 14-pound lines. The hooks were of three sizes, called Numbers 6283, 6284, and a rarely used smaller cod hook, in order of decreasing size. The term fine gear in a restricted sense was applied to the 28-pound ground line, the 10-pound gangings, and the 6284 hook. The standard gear was, and is, 48-pound ground line, 16-pound gangings, and Number 6283 hook.

This modified gear had been adopted particularly by the dory boats which were fishing on southern grounds during the summer months. It was not and still is not considered good for use where the strain upon the lines is great, either from deep water, foul bottom, great weight of fish, very large fish, or the presence of many dogfish, etc. As a consequence this gear was and is largely confined to the southern fishery and particularly to boats fishing small fish for the Seattle markets.

The use of this fine gear and of intermediate types was shown by inquiry among the Seattle fleet and dealers to have begun in 1925. The subsequent increased use of this lighter gear can be seen from the records of one of the larger firms, which is shown in Table 11 in terms of percentage of the total 10, 14, and 16-pound gangings sold. The units are of length, the line being known by the weight per unit length. No records previous to 1924 were available.

TABLE 11.—*Percentage of gangings of different weights sold by a large Seattle outfitter from 1924 to 1929.*

Weight of Line in Pounds	Percentage					
	1924	1925	1926	1927	1928	1929
10	4	8	16	15	13	16
14	4	8	20	21	25	17
16	92	84	64	64	62	67

During 1926, extensive fishing experiments were made to contrast the catches by 10-pound gangings and 6284 hooks with those by 16-pound gangings and 6283 hooks. The results of these experiments, which have been in part reported upon (Thompson, 1926), indicate that the efficiency of the gear with the smaller gangings and hooks is much greater, not for small fish only, but equally for all sizes. Correction will obviously be necessary whenever any considerable amount of such gear occurs in our records.

Our log records until the year 1929 fortunately contain, as far as we know, no returns from vessels using fine gear. Whatever correction is possible would apply only to the years since 1926 and more particularly to the records which were gathered in the port of Seattle since the present analysis was completed and which are not included in the present report. Correction of our catch records does not appear necessary. Detailed consideration of the relative efficiency of standard and fine gear is left for some later report, where the numbers of catch records by fine gear included may warrant the application of a correction.

ACCURACY OF ESTIMATED CATCH

The degree of accuracy reached by the captains in measuring the catch is of paramount importance. It is therefore of interest to know how the amounts of fish taken are arrived at.

The capacity of the checkers, in which the fish are stored on deck before being dressed, is known, and the estimate is partly the result of the application of this measure. Again, the men who ice the fish in the pens in the hold become very expert at telling by the space filled just how much fish is put away each day. This is still another method of measuring. The result of the combined application of the two gives something better than an estimate, even to the relative amounts of large, medium, and chickens.

The only data with which comparison can be made to get an idea of the accuracy of these amounts are the "weighed-out" weights of the dealers. In making such a comparison the errors due to weight lost through culling and to the practice of buying third-class fish at two for one must be borne in mind. These are reduced to a minimum by using the weighed-out weights

of trips landed at such a port as Prince Rupert in very recent years. At Prince Rupert third-class fish have never been bought, and during recent years the method of caring for the fish on the boats has been so good and market conditions so favorable, that on the average but a very small proportion of the actual catch has been rejected by the dealers.

A comparison of the captains' log records and dealers' weights has been made for all possible trips landed at Prince Rupert during March and April of 1926, the period for which our log records are most numerous. Of the 485 trips actually offered on the exchange, 257, or 53 per cent are represented in the logs from 125 different boats of all sizes. The analysis considered both the individual and average deviations of the dealers' from the log weights.

The total weight shown by the logs from these trips was 4,112,580 pounds, whereas the dealers' weights totalled 4,176,141 pounds, a difference of 63,561 pounds or 1.5 per cent of the log weights. This difference was

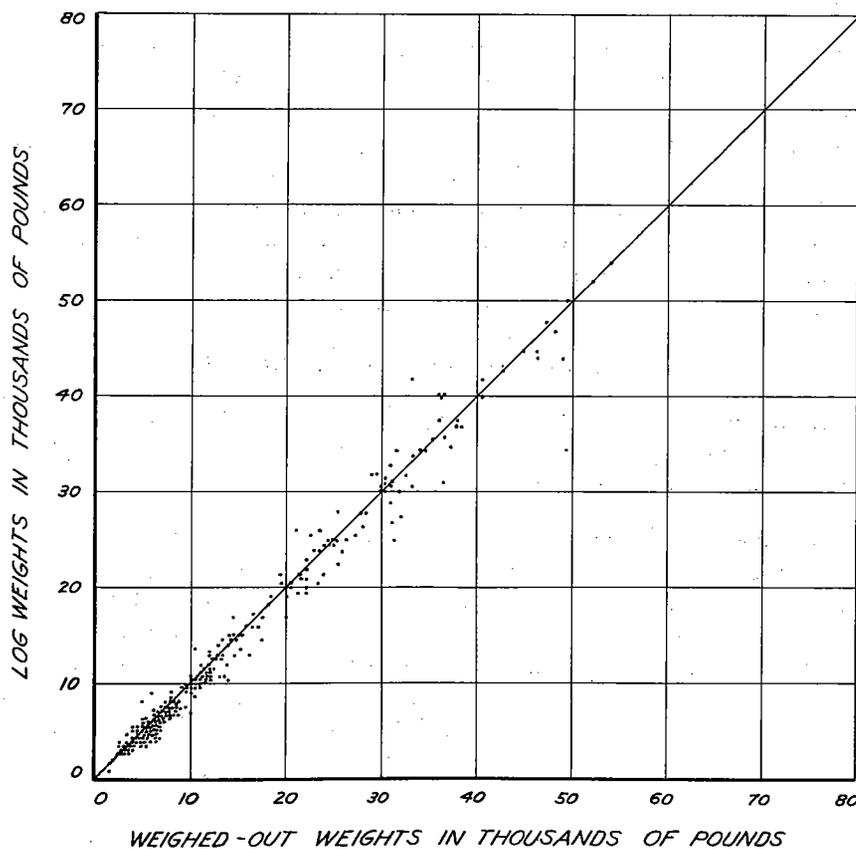


FIGURE 12.—Comparison of weights as given in log books and as weighed-out at landing, for 256 trips landed at Prince Rupert in March and April, 1926. Each dot indicates the two weight records for a single trip, and should lie on the diagonal line if these correspond exactly.

expected as the fishermen in general tend to be conservative in their estimates, preferring to underestimate rather than to overestimate their catch.

Individual trips, of course, vary more widely than does the average. The extent of this variation is indicated in Figure 12, where the log and weighed-out weights are plotted one against the other for each trip. However, in any use to which these data are put in the following pages the records of many trips are combined, balancing variations one against the other to produce a more accurate average.

It is apparent that the individual weights obtained from log records show fairly accurately the actual amount of fish caught, and that on the average they do so with great exactness. They are therefore entirely suitable for use in an analysis where the results obtained are averages based on large numbers of records.

HISTORICAL BACKGROUND OF LOG RECORDS

In order to understand the statistics of the catch it is necessary to have a background of knowledge as to the history of the fishery on the different sections of the coast (Thompson and Freeman, 1930). The fishery has maintained itself by constant expansion of grounds and increasing efficiency in handling the gear. Sail has given place to power, gasoline and distillate to Diesel fuel. Where the catch once came from 500 miles of coast, it now comes from 2000. Where once prices were 2 or 3 cents per pound they have for years been between 10 and 15 cents. Only by understanding these facts, that the progress in efficiency of method and the increased demand have counterbalanced the decline in yield, can the continuity of this decline be understood. Had it not been so counterbalanced it must have many years ago come to an equilibrium at a higher level of abundance—perhaps a more productive one.

The commercial fishery began in 1888, with voyages by sailing vessels to banks off Cape Flattery and the Canadian coast. And on these same grounds it grew steadily with the expansion of eastern markets until 1910. As early as 1895 steamers played an important part, and in after years the records of their catches, gathered carefully, gave a much needed insight into what had happened. Bank by bank these older grounds were stripped of their fish, while a new fleet of powered schooners developed, capable of carrying on the new deep-sea fishery to come. Then in 1910 new banks in deeper water and farther north were opened and there ensued a period of rapid expansion, schooners reaching as far as Cape St. Elias in 1913, and the larger vessels as far as Portlock Bank in 1914. The opening in 1914 of a new route via Prince Rupert to the eastern markets, a brief period of heavy yields from new banks south of Cape Flattery, overproduction, and the complications of war, occupied the years until 1921. The invention and perfection of the Diesel engine gave a new impetus to expansion, and

in that year the fleet began intensive use of the banks west of the Gulf of Alaska.

The oldest records of the fishery therefore apply to the grounds first exploited off Cape Flattery and British Columbia. Records have been preserved of steamer catches made off British Columbia for the period 1902 to 1915, but few have been kept for other types of vessels. The present staff has collected records from all classes of boats for this region for the period 1913 to date, thus completing a splendid series for the most important section of the fishery.

For the other sections data are available in accord with the briefer history of each. Fortunately the steamers of the Canadian Fish and Cold Storage Company fished Portlock Bank in 1915, and their logs have been invaluable, giving a record for that bank from 1915 to date. But in general the periods of expansion south, as well as north or west, are reflected in the log records obtained, as can be seen from Appendix A.

DEFINITION OF STATISTICAL AREAS

For convenience in analyzing the statistics, the coast line has been divided into areas. It has been impossible, without far more exact knowledge than is available, to make these areas equal in extent of actual fishing ground. Nor would this be desirable, in that on such a long coast, with narrow coastal banks, the migrations of the fish, the drift of eggs and larvae, and the movements of the fleet must be considered mainly from the standpoint of the length of coast line. The cost of operations and the difficulty of reaching the various sections of the banks vary as the distance from the ports, making the economic factors dependent upon this length rather than upon the width of the banks.

To form these areas, a base line has been established paralleling the trend of the coast; and at distances equal to one degree of the corresponding latitude, lines have been drawn at right angles to the base line. These separate the areas. Where for various reasons the area is not a unit, subdivisions may be made. Thus area 12 is composed of a section along the West Coast of the Queen Charlottes, another in Hecate Strait termed the inner banks in Table 23, and a third the inland passages.

The areas are shown on the charts reproduced in Figures 1, 2, and 3. They are numbered consecutively from south to north, covering that part of the Pacific Coast of North America on which commercial halibut fishing has been conducted to date. Statistical area 6 is opposite the entrance to the Strait of San Juan de Fuca, 11 to 13 are opposite the Queen Charlotte Islands, 20 and 21 are off Yakutat Bay, 27 and 28 are off Kodiak Island, and 35 is at Unimak Pass.

ANALYSIS OF LOG RECORDS

SECTION 1:

DECLINE IN ABUNDANCE IN THE SEVERAL SECTIONS OF THE COAST

The analysis of the log data which follows is divided into three main sections. First to be considered is the history of the different banks from the standpoint of changes in abundance. The second is the present condition of the fishery. The third deals with seasonal fluctuations in abundance and the changes the fishery has produced in these during recent years.

In general, the numbers of log records become progressively fewer as we go back from the present to the earlier years. Even for the earliest year, however, there are probably sufficient records to give an approximate idea of the abundance of fish on the older banks then used. For purposes of analysis it has been deemed advisable to divide the fishing grounds into groups of areas that correspond very closely to natural divisions of the fishery, and to use these rather than the small individual areas, since such grouping tends to smooth out the smaller natural fluctuations. For the same reasons, seasonal analysis of early years is confined to groups of years. In all cases, care is taken to include sufficient data to remove all doubts of the validity of the results obtained.

The catch records, extending from 1913 to 1928, obtained from the log books of the fishing vessels, are given in detail in Appendix A, but are summarized in Table 12. This gives the total number of sets of 6-line skates, the total catch in pounds, and the computed average catch per skate-set, for groups of areas and for all areas combined for each year. Since the skates used by the boats were of three lengths, the original numbers of skate-sets were changed to a number of 6-line skate-sets equivalent in length.

DECLINE IN AREAS 9 TO 13

It is in the study of yields in the older areas, 9 to 13, that the log records become most valuable, as they cover a considerable period, and these will be dealt with first. There are records, preserved from the research carried on in 1915 and 1916 (Thompson, 1915, 1916, and 1917), showing the average catch per skate-set of five steamers operating out of Vancouver, B. C. from 1906 to 1915 inclusive. In Tables 13 and 14 are reproduced Tables 16 and 17 of Thompson (1916, p. S 84), uncorrected for length of skate. The addition of these to the series gathered in the present research, including records as far back as 1913, provides a splendid series for the study of the falling abundance in areas 9 to 13 inclusive, since 1906.

TABLE 13¹.—*Weight of halibut caught per skate-set, as recorded for five steamers*².

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
1902	.....	.....	.....	.....	.....	.....	.....	.....	1,307	1,000	.....	.....
1903	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
1904	.....	.....	.....	.....	.....	.....	.....	.....	.....	233	321	.....
1905	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
1906	.....	.....	.....	.....	395	973	139	438	649	201	650	453
1907	310	460	483	582	507	516	473	430	316	609	454	324
1908	270	299	318	308	234	486	710	454	588	210	412	257
1909	189	227	229	538	485	334	.....	456	211	161	192	.....
1910	500	344	246	619	492	.....	.....	556	500	166	.....	.....
1911	562	354	200	276	537	627	316	325	322	241	226	210
1912	145	138	200	223	244	314	289	367	220	165	130	122
1913	.....	.....	117	131	201	205	78	69	171	99	84	115
1914	95	169	126	166	257	131	136	125	120	69	97	.....
1915	.....	.....	.....	.....	.....	142	138	128	111	.....	.....	.....

¹From Thompson, 1916, Table 16, p. S 84.²These averages are based on the individual catches, not on the averages for each vessel.

The commercial fishery in areas 9 to 13, including Goose Island Grounds, Hecate Strait, the West Coast of the Queen Charlotte Islands, and the southern side of Dixon Entrance, began in earnest about 1894 or 1895. Fishing was at first very much localized, but as the catch fell the fishing area was extended to new grounds. By 1906, the year when the dependable series of log records begins, most of the shallower grounds in this region were being exploited.

TABLE 14¹.—*Weight caught per skate-set in areas 9 to 13, showing averages for such periods as are best compared from 1906 to 1912, as uncorrected and as corrected for length.*

Year	Whole Year Uncorrected	January to May Inclusive, Uncorrected	May, August, September, October		
			Uncorrected	Average Length of Skate	Corrected to 6-line Skate
1906	.....	.....	421	10.0 lines	253
1907	455	468	466	10.0 "	280
1908	379	286	372	10.0 "	223
1909	.....	334	328	10.0 "	197
1910	.....	440	429	9.5 "	271
1911	350	386	356	9.0 "	237
1912	213	190	249	8.5 "	176

¹From Thompson, 1916, Table 17, p. S 84.

In Table 14 are given in the second, third, and fourth columns the weights caught per skate, uncorrected for length as given by Thompson (1916, Table 17), for varying periods of comparable times, giving some idea of the variability in data. In the fifth column is given the average length of skate which was in use each year as ascertained by recent work, and in the sixth the catch per skate as corrected for length to the basis of 6-line skates.² In Table 12 are given the average yearly catches from

²These values are not identical with those used in Table 1, comparing the catch per skate and per fishing hour. There the data were selected so as to provide a correct comparison according to voyage, with regard to season but without regard to the accuracy of the ascertained decline.

TABLE 12.—Number of sets of 6-line skates fished, total weights caught, and average catch per skate by groups of areas for each year from 1913 to 1928.

Year	Areas 1-8			Areas 9-13			Areas 14-18			Areas 19-23			Areas 24-28			Areas 29-36			Total		
	Skates	Pounds	Average	Skates	Pounds	Average	Skates	Pounds	Average	Skates	Pounds	Average	Skates	Pounds	Average	Skates	Pounds	Average	Skates	Pounds	Average
1913	.....	.....	.....	8,976	1,157,400	129	.....	.....	.....	88	9,000	102	.....	.....	.....	.....	.....	.....	9,064	1,166,400	129
1914	.....	.....	.....	11,887	1,460,115	123	166	36,000	217	1,035	218,000	211	181	40,000	221	.....	.....	.....	13,269	1,754,115	132
1915	585	180,200	308	17,885	1,983,500	111	1,031	137,900	134	5,347	1,713,197	320	9,967	2,361,844	237	.....	.....	.....	34,815	6,376,641	183
1916	1,016	136,650	134	8,424	898,549	107	927	152,435	165	9,903	2,256,843	228	4,140	591,222	143	.....	.....	.....	24,410	4,035,699	165
1917	1,625	110,500	68	10,558	889,420	84	1,349	107,176	79	8,401	1,332,271	158	5,880	922,041	157	.....	.....	.....	27,813	3,361,408	121
1918	1,663	128,120	77	8,099	699,825	86	922	106,738	116	8,192	1,030,506	126	5,606	699,312	125	.....	.....	.....	24,482	2,664,501	109
1919	574	22,600	39	9,563	787,915	82	1,595	155,286	97	12,536	1,750,847	140	8,959	1,042,024	116	.....	.....	.....	33,227	3,758,672	113
1920	102	7,800	76	10,736	884,128	82	4,823	425,347	88	9,374	1,339,155	143	10,458	1,591,555	152	408	63,602	156	35,901	4,311,587	120
1921	4,502	326,700	73	15,190	1,224,309	81	7,295	524,095	72	9,178	1,627,015	177	11,856	1,358,940	115	1,383	183,714	133	49,404	5,244,773	106
1922	1,993	103,350	52	15,276	1,007,534	66	11,069	663,127	60	11,377	1,581,150	139	13,289	1,753,200	132	118	7,000	59	53,122	5,115,361	96
1923	4,479	153,600	35	22,697	1,282,899	57	11,137	749,485	67	13,796	2,260,600	164	15,854	2,186,093	138	970	154,000	159	68,933	6,791,677	99
1924	2,758	77,030	28	22,764	1,308,252	57	9,859	588,371	60	17,238	1,661,210	96	34,798	4,015,843	115	3,045	366,000	118	90,462	8,016,706	89
1925	2,815	103,499	37	22,740	1,188,118	52	14,616	790,868	54	18,981	1,421,105	75	44,298	4,561,981	103	14,565	1,429,450	98	118,015	9,495,021	80
1926	5,609	208,896	37	91,124	4,455,219	49	56,899	3,357,936	59	30,732	2,347,435	76	96,660	9,364,027	97	34,144	3,492,554	102	315,168	23,226,067	74
1927	2,889	106,408	37	60,289	2,808,150	47	28,963	1,635,095	56	32,126	2,539,610	79	63,995	5,463,968	85	31,600	3,098,302	102	219,862	15,651,533	71
1928	15,490	483,951	31	109,972	5,304,480	48	37,640	2,015,271	54	57,424	3,771,762	66	108,405	8,053,053	74	36,726	2,914,611	79	365,657	22,543,128	62

the records collected during the present investigation, and corrected also to the basis of 6-line skates. It covers the combined areas 9 to 13 from 1913 to 1928 inclusive. The corrected data from the two tables are combined for the years 1906 to 1928 inclusive, and are shown graphically in Figure 13.

During the 22 years between 1906 and 1928, the average catch in areas 9 to 13 dropped from 253 to 48 pounds per skate, a fall of 80.5 per cent.

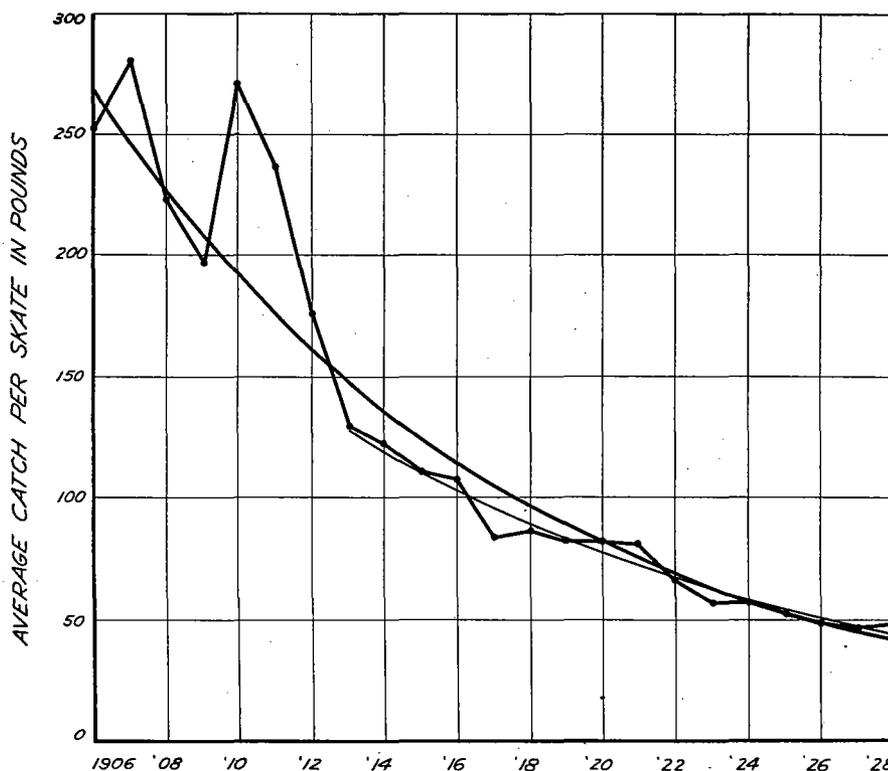


FIGURE 13.—Weight caught per 6-line skate-set in areas 9 to 13 from 1906 to 1928. Fitted with heavy line of even rate of fall (8.15 per cent per year) from 1906 to 1928, and lighter line of even rate of fall from 1913 to 1928.

The figures from 1906 to 1913 will bear closer scrutiny. They are very apparently irregular, with a crest in 1907 and another in 1910. The catches record, in fact, two successive declines, first of the inshore banks, then of the newly discovered (1910) deeper and offshore banks. In this irregularity is seen a common phenomenon during the depletion of the halibut banks, the "discovery" of less overfished banks which temporarily halt the decline. Not often are discoveries on such a scale, but they constitute the continual advance of the fishery and tend to keep up the general level of the yield. In so far as the advance is irregular, by jumps, and in so far as the successively utilized banks are richer or poorer, so does the yield per skate-set fluctuate in its decline.

It will be noted that for the years 1906 to 1912 inclusive, the returns for but four months in each year are used. However, the essential correctness of the data is indicated by the accompanying returns for full years, four in number, and by the returns for the first six months of each of six years. Without discussing in detail the variability between these series it may be said that this will not change greatly any conclusions drawn as to the decline, except that the acceptance of the figure for 1912 in the third column brings the catch for that year more in line with the data for subsequent years.

A more complete analysis can be made by the use of geometric means for each year using 1911 as a standard, and comparing in each year only those months for which data are given both for the year in question and for 1911, as shown in Table 13. The use of the geometric mean gives results which vary from those produced by the more understandable arithmetic mean. The ratios of the catches in each year to those in 1911 were thus obtained, and the results are expressed in Table 15 as a comparison with the average catch for 1911 brought to a standard of 356 pounds, and in the fourth column these are corrected for the length of skate to a 6-line standard using the average length of skate as determined in Table 3.

TABLE 15.—*Weight caught per skate-set in areas 9 to 13, for the years 1906 to 1915, as calculated from Table 10 by the use of geometric means of comparable seasons.*

Year	Calculated Averages	Number of Lines per Skate	Corrected to a 6-line Skate
1906	454	10.0	272
1907	487	10.0	292
1908	387	10.0	232
1909	288	10.0	173
1910	423	9.5	267
1911	356	9.0	237
1912	219	8.5	155
1913	138	8.0	104
1914	135	8.0	101
1915	121	8.0	91

The curve for the catch per skate in Figure 13 seems to flatten out as the years go on. This apparent flattening is readily explained. The fall from 1908 to 1909 is seemingly greater than that from 1919 to 1920, but as an actual fact it is almost exactly the same percentage fall. By starting with a catch per skate of 270 pounds in 1906 and reducing this each year by the same percentage, to 91.85 per cent of the preceding, the series of values shown by the smooth curve (Figure 13) are given, and this curve fits remarkably well the more irregular actual data. It is possible that the rate of fall was a little higher than that indicated by the smooth curve in the early years and a little less in the late years. In short, the rate of fall in the catch per skate is irregular but approximately equal throughout the history of the bank.

A much better way to show this is to plot the actual rates of fall year by year. This could be done by plotting the percentage that each year was of its predecessor, but can be accomplished much more accurately by the use of logarithms of the actual catches per skate. These logarithms are plotted in Figure 14, and the straight line of closest fit drawn through them emphasizes the character of the actual fall as a more or less even one, no less in recent years than in the earlier.

The irregularity in the data is for the larger part in the years preceding 1913. This was the period of rapid expansion of the banks, and from 1913 on (inclusive) the data represent not merely the fishery in protected waters, but also that on the outer coast. Moreover the amount of data utilized is greater for each successive year. By considering only the years 1913 and on, the regularity of the decline becomes still more pronounced, as is shown by the shorter straight line fitted to the logarithms in Figure 14.

There is some hint of a decreasing rate of fall, a flattening out of the curve, if the data from 1910 on are considered, leading to a surmise that the fishery is tending toward an equilibrium and a cessation of the fall. But the constancy of the rate of fall from 1913 on indicates that if present this tendency ceased in 1913.

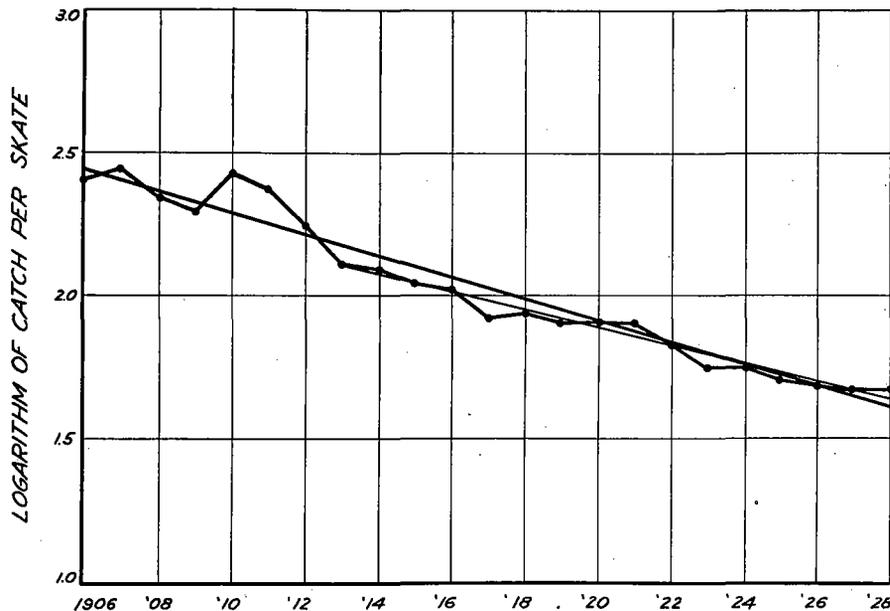


FIGURE 14.—Logarithms of weight caught per 6-line skate-set in areas 9 to 13 from 1906 to 1928. Fitted with straight lines to correspond with Figure 13.

From the appearance of the returns for 1927 and 1928 in Figures 13 and 14, it might be argued that catch and replacement were in those years approaching a condition of stability. This most certainly is not the

case, as a survey of 1929 log records indicates that the average catch is around 40 pounds in that year, and the slight upturn in the catch per unit is a temporary fluctuation such as previously occurred in 1920 and 1921. To summarize this evidence of decline in abundance in areas 9 to 13 there is a fall of 81 per cent from 1906 to 1928—in 22 years the catch per skate has fallen to 19 per cent of its original size. This fall is sufficient to indicate the fact of greatly lessened abundance.

DECLINE IN AREAS 1 TO 8

To understand the fall in abundance of halibut in areas 1 to 8 as shown by Table 12 and Figure 15, some knowledge of the history of this fishery is necessary. This region was fished from the beginning of the commercial fishery, and had been deserted by most of the fleet for the more densely populated banks to the north. In 1915, however, new banks of limited size were discovered off the coast of Oregon. The Seattle fleet concentrated

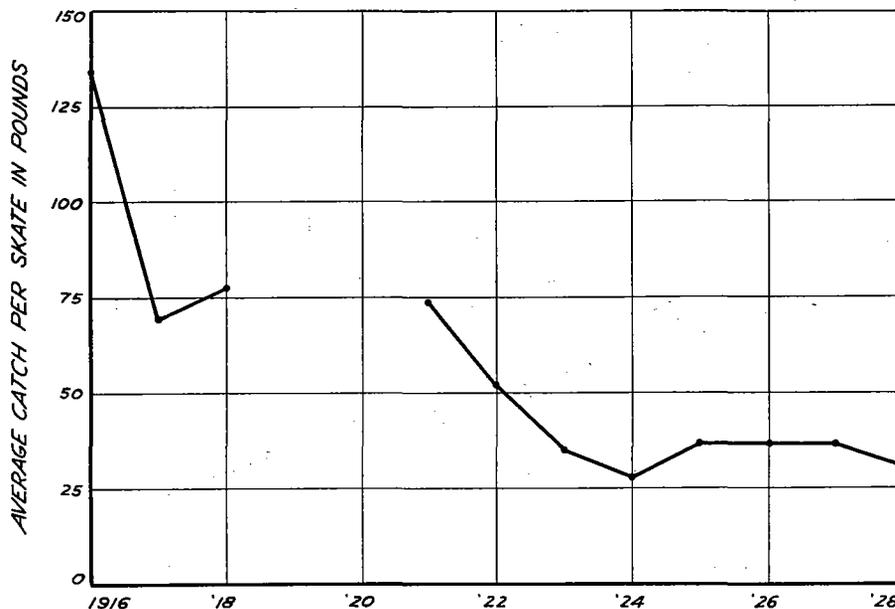


FIGURE 15.—Average weight caught per 6-line skate-set in areas 1 to 8 from 1916 to 1928, omitting 1919 and 1920 as having insufficient data.

on these and soon reduced the abundance of the halibut to the level of the adjacent banks and then returned to the northern banks. Some of the smaller boats have continued to fish in these areas and have driven the abundance still lower. At the present time the returns from here are so poor that the majority of the boats no longer depend on halibut alone, but also bring in black cod, ling cod, and red snapper, relying on these to

augment the halibut catch sufficiently to make fishing profitable. All log records from these areas that indicate fishing for mixed fish have been omitted from this analysis.

The records available for 1915 and 1916 are all from fishing trips on the then newly discovered banks off Oregon and do not apply to conditions in the region as a whole. The 1915 records are too few to be entirely reliable, though they do indicate with reasonable certainty the general condition that existed. The great accumulated stocks were quickly reduced, the catch falling from 308 to 134 pounds per skate in one year on these new banks. The decline throughout the whole region from 1917 to 1928, as indicated by our log records, is similar to that in areas 9 to 13 for the same period but is not so abrupt, indicating that the rates of capture and replacement were nearing a state of equilibrium. The level of the catches from 1923 to 1928 inclusive, suggests that this condition has been reached.

DECLINE IN AREAS 14 TO 18

The fishery in Southeastern Alaska (areas 14 to 18) began about 1895 but was of little importance for a few years. From 1900, however, it showed steady growth, though only the sheltered waters were fished. In 1910 the offshore grounds were discovered here as in British Columbia (areas 9 to 13) and the fishery received new impetus. The larger steamers concentrated on these grounds, and their number was rapidly augmented by new powered schooners seaworthy enough to fish offshore. By 1914, when our catch records begin, the catches had already fallen, and the more able boats had turned their attention to newly discovered banks farther north and west. As time went on, more and more boats moved from these grounds, and the fishery at the present time is maintained principally by the smaller boats, though some of the dory boats occasionally resort to them in the summer months for the small fish.

Because of the fewness of the records, the catches for 1914 are not entirely reliable, as they are from 1915 to the present, but as the catch is in agreement with the trend for the following years it is included for purposes of comparison. Allowing for irregularities the catch fell from about 180 to 54 pounds per skate in the 14 years from 1914 to 1928, a decline of 70 per cent as compared to the decline of 61 per cent in areas 9 to 13 for the same period. The declines in the two regions are very similar, as would be expected, considering their proximity. The level of abundance in areas 14 to 18 remains constantly a little higher than in 9 to 13, a difference probably due to economic factors, chief of which is no doubt the greater distance from the markets paying the highest prices.

DECLINE IN AREAS 19 TO 23

In view of the exhaustion of the older banks, there is, naturally, great curiosity as to what is happening on the newer western banks. What changes have been produced by the fishing efforts of man, what is the

present level of abundance, and what is the future outlook of the fishery on these banks? These areas will be considered by groups, in order of their first exploitation.

Areas 19 to 23, which include the Cape Fairweather, Yakutat Bay, Icy Bay, W, and Cape St. Elias Grounds, were first exploited in 1913. It had been known for many years that halibut were abundant in at least some parts of this region (Thompson and Freeman, 1930, p. 20), but catches had

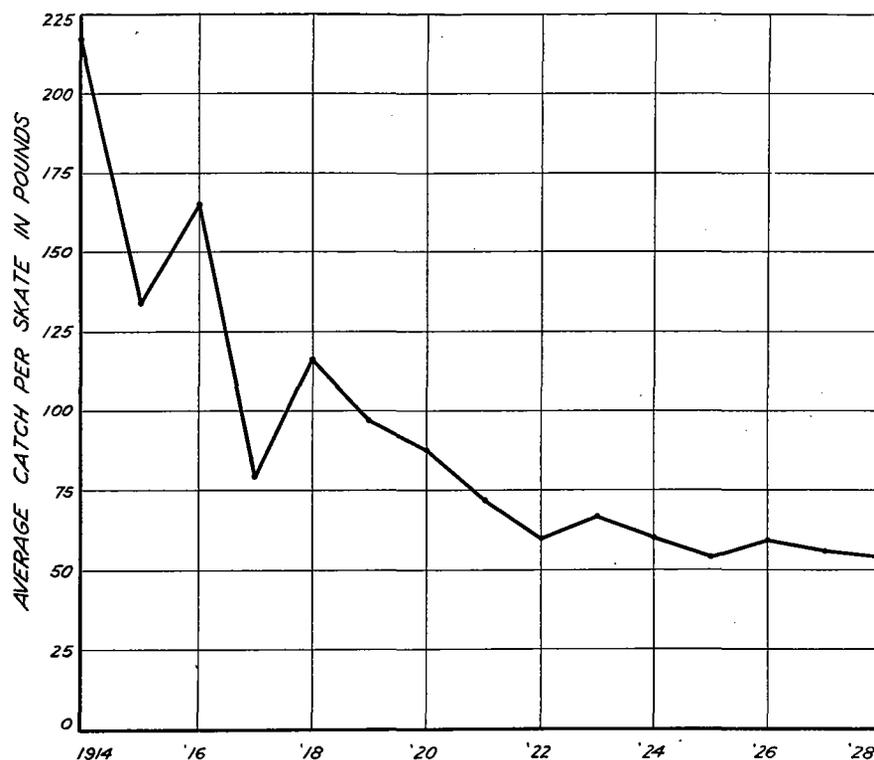


FIGURE 16.—Average weight caught per 6-line skate-set in areas 14 to 18 from 1915 to 1928.

been so good on the banks already known that the boats had never considered it necessary or worth while to go so far from the port of landing and out into such unsheltered waters. By this time, however, the level of abundance on the known banks had fallen so far that the larger boats, which were more costly to operate, were not making the desired profits and began fishing between Cape Spencer and Cape St. Elias on previously unexploited grounds where the catches obtained were so much better as to more than offset the extra time spent on the run between the port of landing and the banks.

All log records of fishing in these areas that have been collected by the commission are summarized in Table 12, where the total number of

skate-sets, catch, and average catch are given for each year. Some records have been obtained for 1913, the first year of this fishery, but these are so few as to be useless for our purpose. The average catches for each year, except 1913, are plotted in Figure 17. The 1914 data are not numerous but nevertheless should give some idea of the catches in that year. Figure 17 therefore gives a very good picture of the abundance of the fish on these grounds, practically from the beginning of the fishery to the present time.

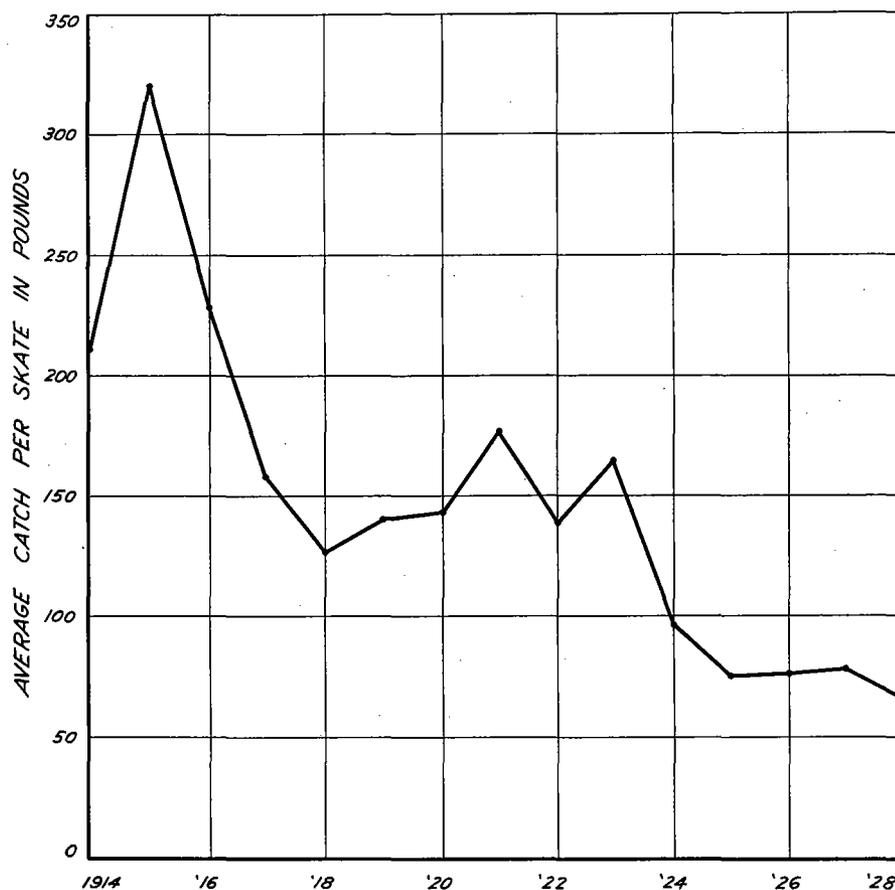


FIGURE 17.—Average weight caught per 6-line skate-set in areas 19 to 23 from 1914 to 1928.

The increased catch from 1914 to 1915 which occurs during the early exploration of these banks is probably reliable and due to a better knowledge of the grounds. The abrupt fall in the catch from 1915 to 1918 agrees with what has been found elsewhere on newly and intensively exploited banks, where the accumulated stock is rapidly removed. The average catch drops from 320 to 126 pounds, a decline of 61 per cent in three years. In the succeeding year the decline not only halts, but an increase in abundance is indicated. This increase continues throughout 1920 and 1921, after which a decline again becomes apparent. This second decline is a slow

one to 1923, but rapid in 1924 and 1925. In 1926 and 1927 a slight increase in abundance is shown, but in 1928 the catch again declines.

The changes produced in the abundance of fish on the bank by the fishery are very pronounced. In the 13 years from 1915 to 1928 the average catch has dropped from 320 to 66 pounds per 6-line skate, a decline of 79 per cent. Although the catch showed no decline from 1925 to 1927, its abrupt drop in 1928 would indicate that the fall is continuing.

Consideration of the significance of the increased abundance during the five years following 1918 and the rapid decline in 1924 and 1925 is necessary. Did such changes actually occur, or are they produced by the regular fluctuations in seasonal abundance in combination with changes in the seasonal distribution of the fishery? The same question might be asked regarding the slight increase in 1926 and 1927. A change in the seasonal distribution certainly did occur in 1924, when one and one-half months, and in 1925 and later, when three months of the winter season were closed to fishing. To what extent, if any, was the inauguration of the closed season responsible for the decline? The consideration of these changes in abundance from this standpoint must be left for a later section (p. 87), where the data are analyzed according to season.

During the years following 1913 the exploitation of these grounds was very intense. The total taken each year must await determination in a later report. But as far as the history as published indicates (Thompson and Freeman, 1930, pp. 39, 44, and 46) the later effects of the World War discouraged distant trips by raising costs and encouraged landings from nearby banks by higher prices. The opening of the Oregon Grounds and the period of overproduction following 1915 added their influence. The number of steamers operating fell rapidly subsequent to 1916 to a fourth by 1921, and the building of the new Diesel-motored vessels did not begin until after 1921. So that it is fair to conclude, pending more detailed study, that the total removed from the grounds after 1915 fell sufficiently so that the stock was able to maintain itself or even recuperate to some extent, at the level of abundance then prevailing.

This is a conclusion of very great interest. It has now been shown by the tagging experiments that the mature fish in these areas migrate widely and freely to the westward and the stocks are continuous with those of the great unexploited areas to the west, so that the reserve recuperative power must have been very great. The fishery being largely for matures, the incoming stocks of newly matured fish left untouched by the brief period of intensive fishery must have been sufficient to restore the fishery for the time being. The fact that a temporary equilibrium was attained and that recuperation began is itself of great theoretical and of practical interest to future regulation.

To corroborate this history of the abundance on this group 19 to 23, the individual areas have been examined separately, as shown in Table

TABLE 16.—Number of sets of 6-line skates, total catch in pounds, and average catch per skate for areas 20, 21, and 22, during January, February, November, and December of each year from 1915 to 1928.

Year	AREA 20			AREA 21			AREA 22		
	Skates	Pounds	Average	Skates	Pounds	Average	Skates	Pounds	Average
1915	.....	.....	.....	1,273	735,000	577	612	262,000	428
1916	462	204,000	442	1,693	484,000	286	236	31,000	131
1917	755	185,000	245	1,784	408,000	228	82	11,000	134
1918	802	201,000	251	1,315	144,000	110	14	2,000	143
1919	1,874	557,000	297	419	133,000	318	171	45,000	263
1920	1,099	277,000	252	1,014	352,000	347	238	69,000	290
1921	1,279	385,500	301	1,752	450,500	257	101	16,000	158
1922	1,059	226,500	214	2,990	598,000	200	499	106,500	214
1923	3,008	697,000	232	2,128	511,000	240	197	58,500	297
1924	1,480	224,000	151	1,376	251,000	182	373	41,000	110
1925	1,732	182,480	105	699	68,900	99	79	11,600	147
1926	682	121,200	178	2,023	203,000	100	812	89,200	110
1927	837	83,467	100	3,194	372,233	117	1,556	195,200	125
1928	1,766	130,645	74	3,851	305,508	79	2,302	202,443	87

16 and Figure 18. The same trends, with some variability, are present. In the section on seasonal analysis the different seasons will be shown to vary similarly, placing the fact and nature of the changes beyond doubt.

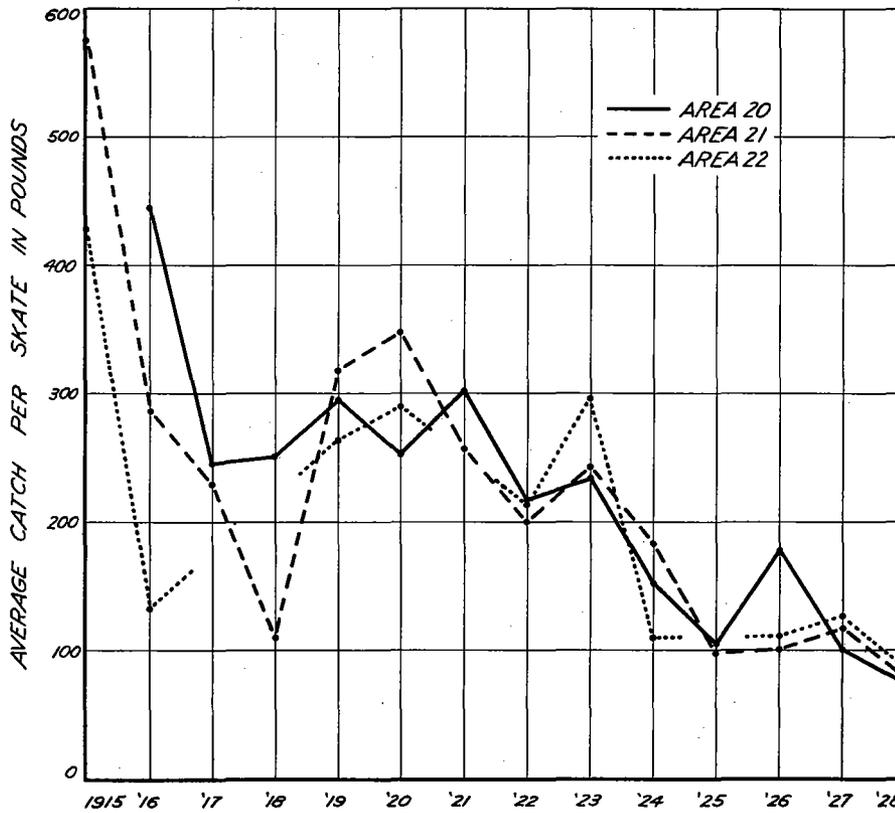


FIGURE 18.—Average weight caught per 6-line skate-set in areas 20, 21, and 22 for the season November to February, 1915 to 1928. Data for various years insufficient and their averages omitted.

DECLINE IN AREAS 24 TO 28

The fishery in areas 24 to 28 began about 1913, but was a small one for a number of years. Portlock Bank probably the most important part of this region, was not fished intensively until 1922 or 1923, when the catch from areas 24 to 28 amounted to one-third of all the halibut catch included in the fishing trials in our records. The way in which the adoption of Diesel power by the fleet facilitated the shift of an intense fishery to this region has been explained in the history of the fishery. The data for 1914 are not considered reliable for these areas in Table 12 and are omitted from Figure 19.

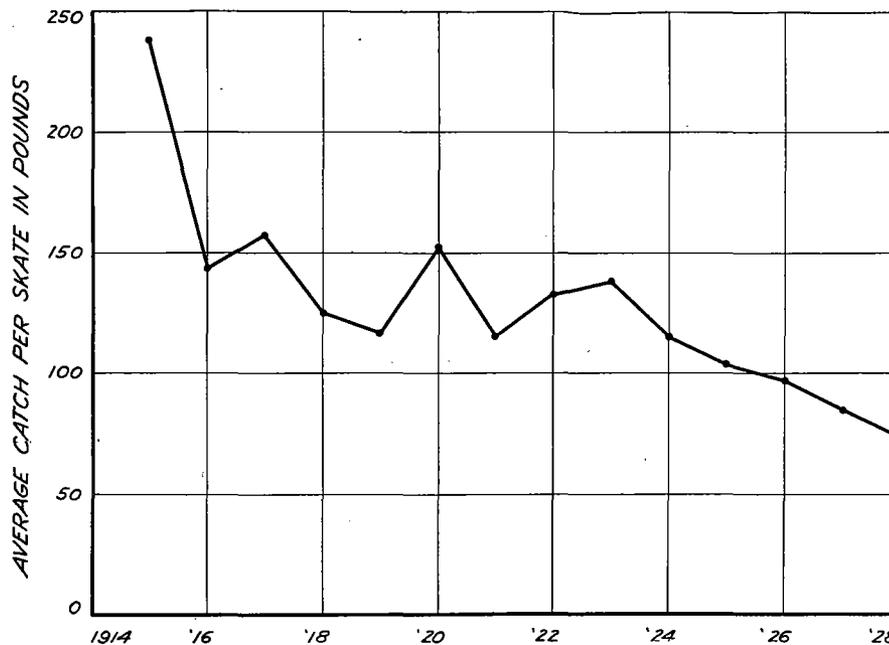


FIGURE 19.—Average weight caught per 6-line skate-set in areas 24 to 28 from 1915 to 1928.

The catch in 1915 was high, but from 1916 on the trend to 1923 is but slightly if at all downward, with the minor fluctuations to be expected during a period of exploration. In view of the great number of records contributing to the averages since 1922, there can be no doubt but that the decline of 47 per cent shown from 1923 to 1928 is a reality. The amount of the decline in 1924 and 1925 may be partially due to the closed season, but that since 1925 is due directly to a reduction of the stock. The fishermen have repeatedly complained that such is the case. In fact, it is a current saying among the fishermen that Portlock Bank, which has been the most productive part of this region, has already been exhausted.

The history of the fishery on Portlock Bank is interesting from the standpoint of the nature of the rise and fall in apparent abundance. The high catch per skate in 1915 reflects the catch in areas 19 to 23, as does the subsequent decline, the maintenance of the general level to 1923, and

the final rapid fall. Evidently the same phenomena have affected the history of these banks as have affected that of the areas referred to above, as should properly be the case if the stocks on the two groups of areas are identical after sexual maturity is reached. This the marking experiments have proved (Thompson and Herrington, 1930). If this stock was first intensively exploited, then allowed to recuperate slightly by a slackening of the fishery due to war and overproduction, and was finally subjected to the intensive fishery of the Diesel-motored vessels after 1921, the changes are understandable. Unfortunately we have as yet no analysis of the changes in the total quantity of fish removed from these two groups of areas.

DECLINE IN AREAS 29 TO 36

The abundance in areas 29 to 36 inclusive, is shown in Figure 20 from Table 12, from 1920 to 1928. The averages for 1920 and 1922 may not be entirely representative due to the limited amount of data on which they are based, and have been omitted. A rise is shown from 1921 to 1923, however, which agrees with what was found in the early exploration of other grounds. The averages from 1923 to 1928 are dependable, being based on large numbers of fishing trials. The fall of 50 per cent in the five years is corroborated by the statements of fishermen. When this is considered in conjunction with the fact that the fishery has been expanding continually farther west in this region and that whereas in 1923 our records include only area 29, in 1925 they included area 33, in 1926 and 1927 area 34, and in 1928 areas 35 and 36, the fall in abundance becomes even more significant.

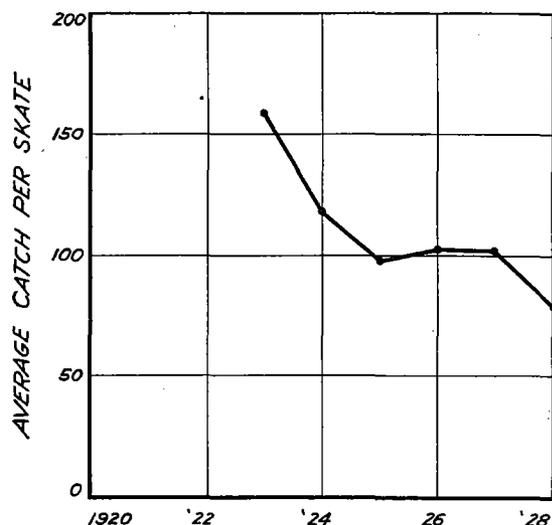


FIGURE 20.—Average weight caught per 6-line skate-set in areas 29 to 36 from 1920 to 1928, omitting 1922 as having insufficient data.

It is noteworthy that the fall from 1923 to 1928 is strikingly alike in the three groups of areas, 19 to 23, 24 to 28, and 29 to 36 (Figure 21). This corroborates the finding that the mature stock on these banks is a

freely migrating unit, with at present a less important stock of non-migratory immatures to cause a certain difference between nearby and more distant banks.

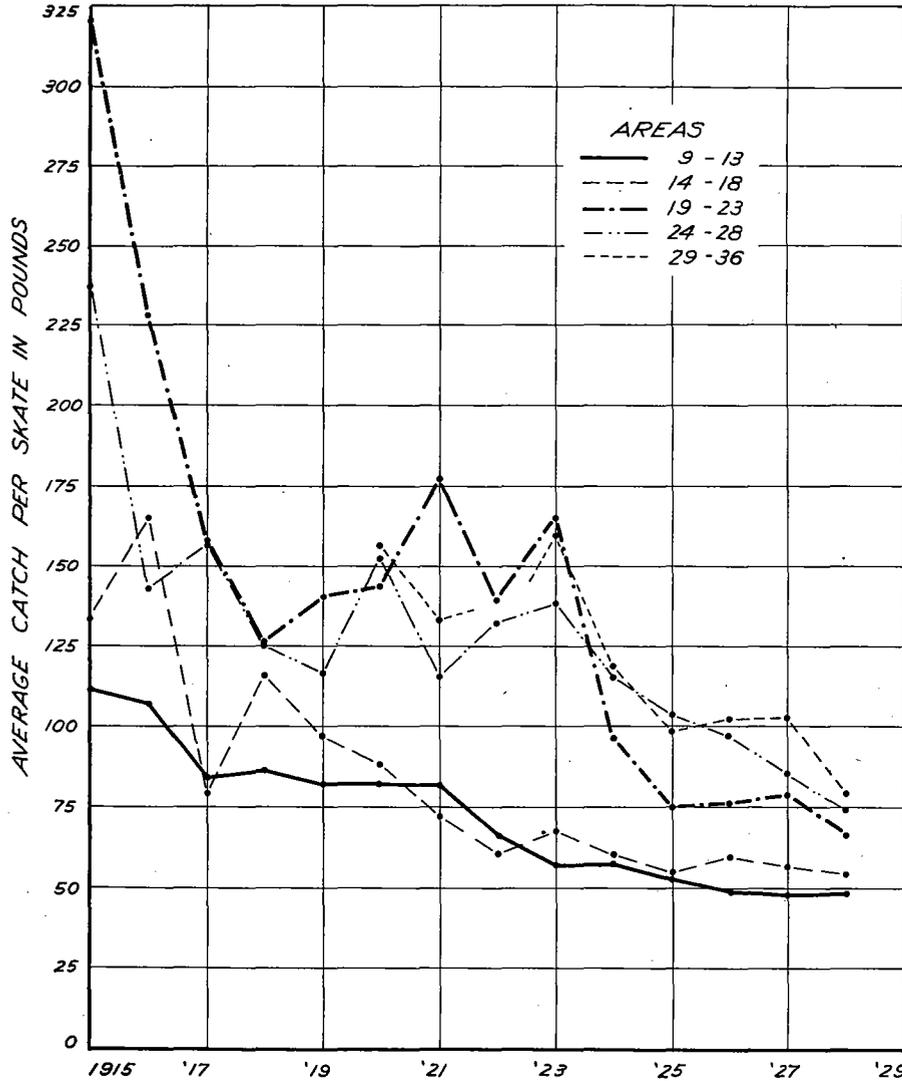


FIGURE 21.—Comparison of decline in average catch per 6-line skate-set in three western groups of areas, 19 to 23, 24 to 28, 29 to 36, from 1915 to 1928.

COMPARISON OF DECLINE ON VARIOUS BANKS

It has been shown that the catch per standardized unit of gear has fallen on all grounds yet fished. When the fall is compared it is seen that the southern banks, areas 9 to 18, have a characteristically even fall since 1911, whereas the banks on areas 19 to 36 show an interruption between 1918 and 1923. Comparison is somewhat difficult between the untreated data shown in Figures 13 to 20, but in Figure 22 the graphs for each region are drawn as smoothed by a moving average.

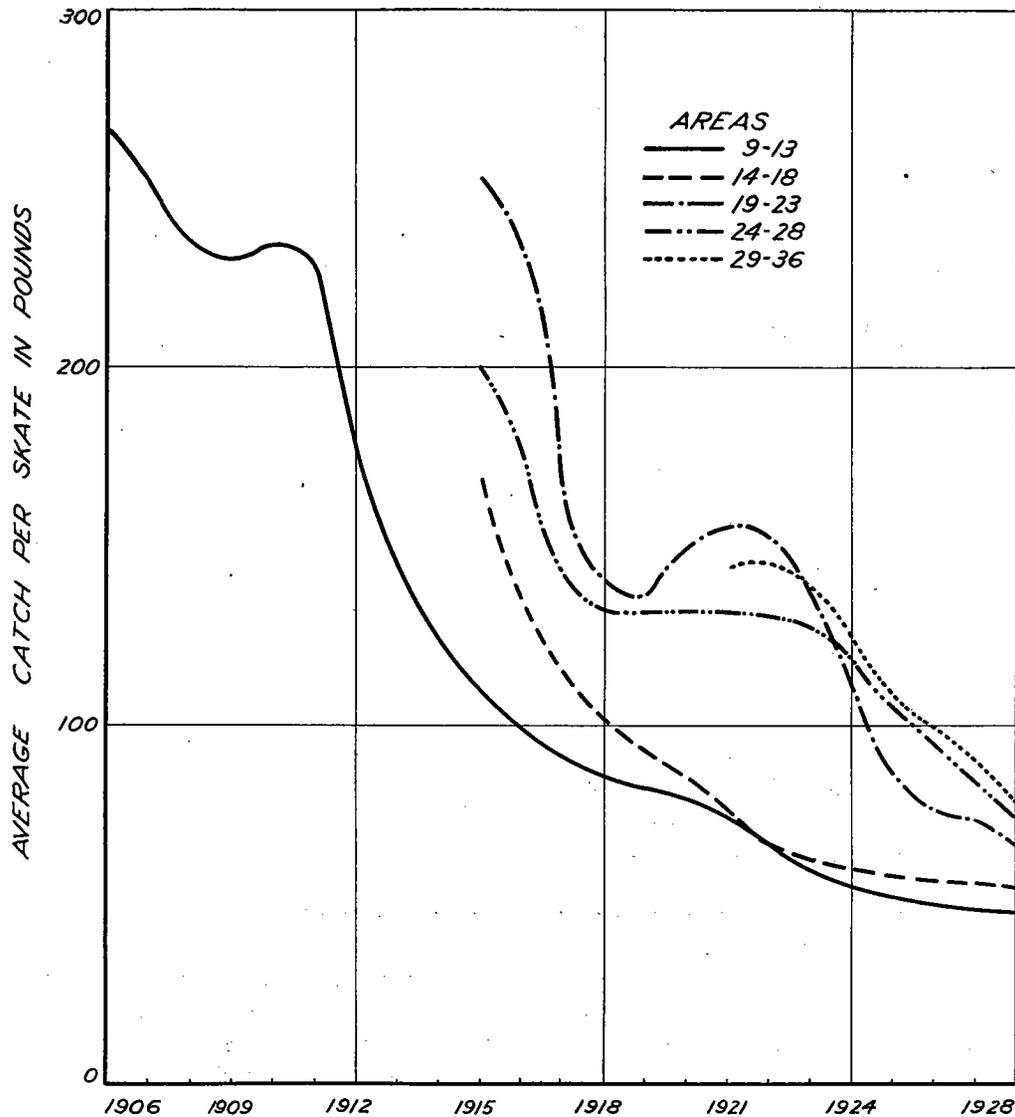


FIGURE 22.—Comparison of decline in average catch per set of a 6-line skate in various groups of areas, 9 to 13, 14 to 18, 19 to 23, 24 to 28, and 29 to 36 during the periods covered by log records. Curves smoothed manually.

The western banks from areas 19 to 36 show a distinct similarity in their decline. This indicates unmistakably the correctness of the results from marking experiments, which have proved that the stock of mature fish on these grounds migrates freely along the long coast line. It will also be noted that although areas 29 to 36 are the most recently exploited, the level of abundance at the time the record begins was practically the same as that of the areas east, 19 to 28. This would indicate that the stock on the far western grounds was actually being utilized whenever areas 19 to 23 were fished. The stock on areas 19 to 36 is therefore practically a unit as far as the commercial sizes are concerned.

The same could not be said of the immature in these areas. The fish on western grounds are of slow-growth, mature males furnishing the bulk of the small fish. The southern grounds have, however, always depended in good part on younger fish, which are larger in size there. A considerable portion of the commercial stock must have been non-migratory immatures even in the early days. As a consequence it would be expected that on different banks different stocks were concerned, and that the initial abundance off Southeastern Alaska might have for some years remained at a higher level than on the nearer banks of Hecate Strait, as long as the greater distance from Seattle or Vancouver required a higher return. Beginning with 1914, when an outlet to the eastern markets was secured through Prince Rupert, the economic reasons which prevented fishing down to a lower level on Southeastern Alaskan banks may have disappeared. At all events the decline there was exceptionally rapid from 1915 to 1921, when the relative catches in Hecate Strait and Southeastern Alaska became more nearly comparable.

A more accurate comparison of the catches on these western banks is made in Figure 21, where unsmoothed data are used. The striking similarity of the change in areas 19 to 23 to that in areas 29 to 36 contrasts with the straight line fall in areas 24 to 28. The fishery varies from one to the other of these groups, but no ready explanation of this difference occurs to us.

It may therefore be concluded that all banks show a decline of great rapidity, but that this has been interrupted on the western banks from 1918 to 1923. The characteristics of the decline and the similarity of the abundance on the western grounds as contrasted to that on the southern indicates the presence of distinct stocks of halibut.

DECLINE IN CATCH FROM ALL BANKS

In view of what has happened in the various groups of areas and the continual inclusion of new grounds by the fishery in its western expansion, it is interesting to see what has happened to the catch on the coast as a whole. This is shown graphically in Figure 23 from Table 12, where the average catch per standard skate is given for each year without regard to area.

The catches show a marked increase from 1913 to 1915 and an almost uninterrupted decline from 1915 to 1928. The 1913 data contained in our records apply only to the long exploited southern banks. The increased catches in the two following years are caused by the inclusion of records from the newly discovered banks in the Gulf of Alaska. In spite of the subsequent extension of the fishery to new grounds farther and farther west, the catch per skate thereafter fell continuously. It is evident that the spread of the fishery to the westward has not been able to maintain the average return per unit of gear fished.

The fall is not at an even rate, an equal percentage each year of the catch of the previous year. It is rather an equal amount annually, hence at an increasingly rapid rate, very different from the fall shown for areas 9 to 13. This is perhaps partly due to the heavy catches during the years

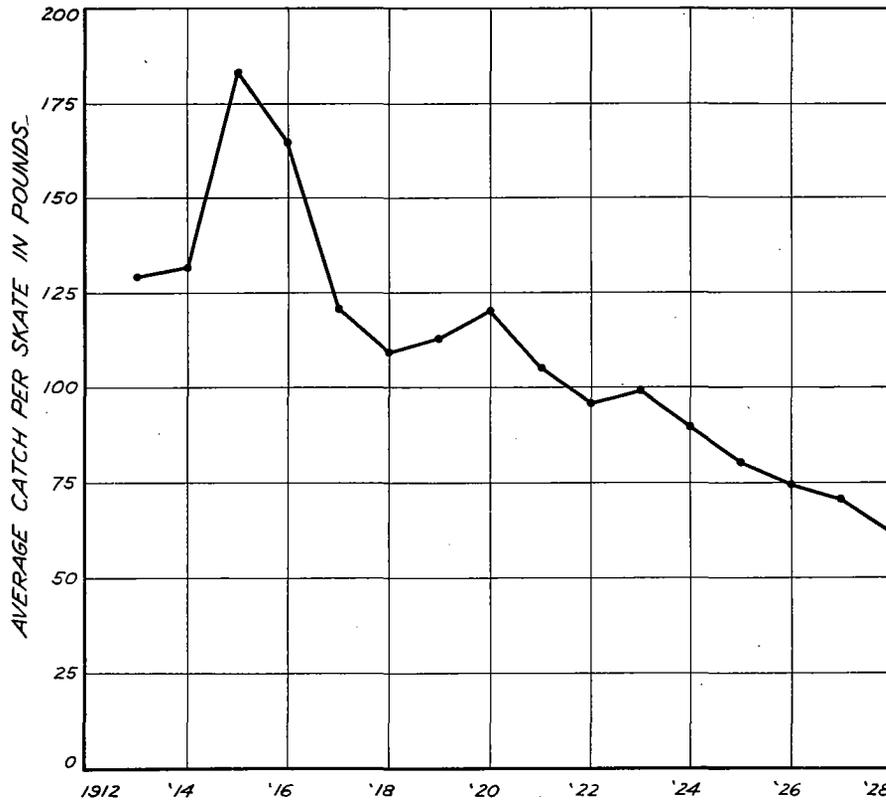


FIGURE 23.—Average weight per 6-line skate-set from 1913 to 1928, for all areas.

1920 to 1923 from areas 19 to 23, but this fails to completely explain the change in rate.

SECTION 2: PRESENT CONDITION OF THE FISHERY

Although in the preceding pages the records of abundance have been dealt with historically for each group of areas, this does not furnish a ready comparison for any one recent year or group of years. During the years 1926, 1927, and 1928 the records have been collected in sufficient quantity to justify a detailed comparison of the individual areas along the whole coast. This will throw light upon the present extent and distribution of the fishery, its nature, and the condition of the banks as compared one with the other at the present time.

Since 1926 many vessels not previously keeping records of their fishing operations have been encouraged to do so and agents have been detailed for their current collection. As a consequence there are a great number of such records for 1926, 1927, and 1928, and these are more representative of the fleet as a whole than those for past years. In the total columns of Table 12 are given the number of sets of unit skates dealt with each year from 1913 to 1928 inclusive, and the greater numbers in the last three years are noticeable. The 315,000 sets and 23,000,000 pounds recorded in 1926 represented 41 per cent of the total commercial catch of halibut on the Pacific Coast. The 220,000 sets in 1927 caught 28 per cent and the 365,000 sets in 1928 accounted for 41 per cent of the commercial catch.

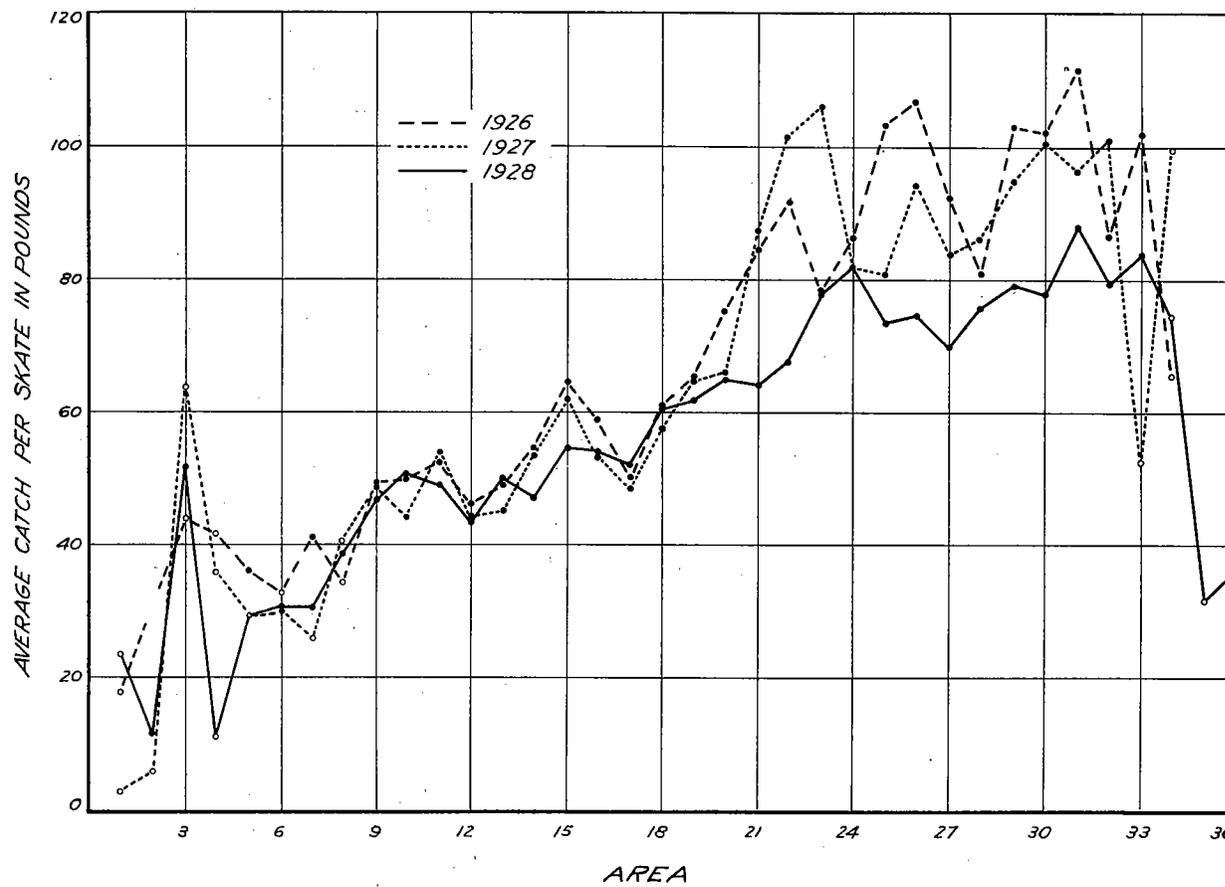


FIGURE 24.—Average weights caught per 6-line skate-set in 1926, 1927, and 1928 for all areas.

The log records have served first of all to give the average yield per skate-set in each of the statistical areas. The total number of skates as corrected to a standard 6-line length, and the total number of pounds of fish recorded for each area for each month have been set down and the average catch per skate-set calculated therefrom. This is a measure of the abundance of halibut.

Without regard to the seasonal changes, the average for the years 1926, 1927, and 1928 have been calculated for each area. This is shown in Table 17, and the variations in the average are shown more graphically in Figure 24, where the relative abundance of halibut, as indicated by the catch per unit, is shown for each area by the height of ordinate above it.

TABLE 17.—Average catch per 6-line skate-set by year and area for all 1926, 1927, and 1928 data.

Area	1926			1927			1928		
	Skates	Pounds	Average	Skates	Pounds	Average	Skates	Pounds	Average
1	303	5,392	17.8	48	112	2.3	815	19,110	23.4
2	-----	-----	-----	10	60	6.0	1,322	21,749	16.5
3	326	14,100	43.3	677	42,955	63.4	1,010	51,780	51.3
4	762	31,800	41.7	42	1,500	35.7	123	1,325	10.8
5	2,022	72,704	36.0	262	7,568	28.9	1,430	40,380	28.2
6	567	18,495	32.6	1,019	30,740	30.2	6,412	194,178	30.3
7	1,548	63,505	41.0	689	17,673	25.7	1,608	48,720	30.3
8	81	2,900	35.8	142	5,800	40.8	2,769	106,709	38.6
9	4,325	209,280	48.4	4,477	218,393	48.8	11,304	529,105	46.8
10	9,836	489,646	49.8	8,872	384,371	43.3	17,814	902,596	50.7
11	19,410	1,012,118	52.1	13,702	730,694	53.3	19,670	955,973	48.6
12	19,133	876,705	45.8	11,328	492,718	43.5	18,242	787,055	43.1
13	38,420	1,867,470	48.6	21,910	981,974	44.8	42,942	2,192,751	49.6
14	11,305	613,450	54.3	4,687	248,213	53.0	6,652	308,604	46.4
15	19,442	1,249,850	64.3	11,465	707,264	61.7	7,994	432,781	54.1
16	13,889	783,247	58.5	4,906	260,617	53.1	10,251	545,828	53.2
17	5,451	272,019	49.9	3,558	171,367	48.2	4,537	232,750	51.3
18	7,312	439,370	60.1	4,347	247,634	57.0	8,206	495,308	60.4
19	6,331	411,850	65.1	8,665	558,484	64.5	11,991	734,670	61.3
20	12,886	962,035	74.7	7,818	513,684	65.7	15,577	1,009,279	64.8
21	5,830	489,850	84.0	9,134	795,149	87.1	15,544	990,154	63.7
22	2,741	252,000	91.9	3,311	334,400	101.0	7,081	474,909	67.1
23	2,944	231,700	78.7	3,198	337,893	105.7	7,232	562,750	77.8
24	9,492	815,409	85.9	7,392	605,429	81.9	10,989	899,710	81.9
25	25,861	2,602,053	102.6	17,331	1,398,513	80.7	31,552	2,333,214	73.9
26	31,257	3,325,440	106.4	14,640	1,377,099	94.1	27,518	2,046,167	74.4
27	13,838	1,274,925	92.1	11,688	973,382	83.3	19,756	1,372,772	69.5
28	16,712	1,346,200	80.6	12,943	1,109,545	85.7	18,591	1,401,190	75.4
29	18,005	1,851,385	102.8	9,769	922,859	94.5	12,046	951,229	79.0
30	8,133	828,534	101.9	12,910	1,292,011	100.1	12,469	967,848	77.6
31	4,097	455,535	111.2	2,084	200,216	96.1	3,487	305,617	87.6
32	2,381	204,900	86.1	5,719	579,716	101.4	6,284	499,417	79.5
33	1,454	147,450	101.4	168	8,750	52.1	1,708	142,600	83.5
34	73	4,750	65.1	951	94,750	99.6	569	42,100	74.0
35	-----	-----	-----	-----	-----	-----	16	500	31.3
36	-----	-----	-----	-----	-----	-----	148	5,300	35.8
Total	315,167	23,226,067	73.7	219,862	15,651,533	71.2	365,659	22,543,128	61.7

By referring to the graph it will be seen that there is a gradation in the abundance of fish from the older to the newer banks in the west. By finding at the bottom the areas 11, 12, and 13 and following up the ordinates until the mark is found showing the amount per skate, it will be seen that the average catch per skate there, in Hecate Strait, was between 46 and 52 pounds in 1926. Off Yakutat in areas 20 and 21 it was 75 to 84 pounds, while off Kodiak Island in areas 27 and 28 it was between 81 and 92 pounds. Similar relationships with some variation exist in 1927 and 1928.

The inference is plain that the southern and older banks are more depleted than are the western and newer banks. Yet there is a good reason for the existence of such a difference in abundance, regardless of the age of the banks, and that is the economic fact that it requires a greater reward to cause the boats to go farther. The expense of running and idleness while at sea must be paid for by a larger yield while on the grounds. From this standpoint, there is good reason why the southern banks have been concentrated upon and the average catch driven lower than that from western banks. The lesser depletion of fish to the westward is the result of economic factors, and the ever shifting center of operations is the result of the lower and lower abundance on the older grounds, making the farther west operations relatively more and more profitable. Every improvement in engines, in fuel, or in speed, makes it possible to exploit the western banks to a greater extent than the older ones and saves the latter.

We see, therefore, in the present distribution of abundance of halibut, good evidence of the depletion of the banks. It supports what has been said as to the general history of the banks and the more than halving of the amount taken from the older banks within 16 years.

The question naturally arises in the mind as to whether, if improved methods of transportation at sea had not been developed, thus leaving the western banks more expensive to reach than they now are, the southern banks would have shown a greater decline than they have. To this there seems no avoiding the answer that prices would have been driven still higher by an increasing scarcity of halibut, supporting a more intense fishery on the older banks, which, in turn, would have driven the level of abundance down at a still more rapid rate.

If the level of abundance depends thus on economic conditions, there would seem to be the best of reason to believe that it can be stabilized at any chosen level. If at a level of abundance such as prevailed in 1910, as much as 53 million pounds of halibut were taken from the older grounds, and if at a greatly reduced level under greatly increased gear only 19½ million were taken (Thompson, 1929, p. 148), it is fair to ask whether at an intermediate level, such as could be restored by the restriction of gear, a much greater and steadier yield could not be expected than is now taken. The increasing intensity of the fishery has led to a declining total catch, not to an increase.

When the three series of data are examined comparatively, several differences are noticed. The most important and conspicuous of these is the general decline in abundance in areas 20 to 32 inclusive, the grounds extending from Yakutat to the Shumagin Islands. The average catch for all these areas in 1926 was 95 pounds per skate; in 1927 it was 89, a drop of 6.3 per cent; and in 1928 it had dropped another 18.0 per cent to 73 pounds. It is apparent that the abundance of fish on the western banks is falling at a very rapid rate, which, if continued, will soon make operation on these grounds difficult under present economic conditions. This is borne out by reports of the fishermen who depend on the grounds for their catches.

Another decline in abundance during the latter two years is very apparent in the average catches taken in area 15 at Cape Addington, South-eastern Alaska. The decline has been from 64 to 54 pounds per skate-set in two years, a drop of 15.6 per cent.

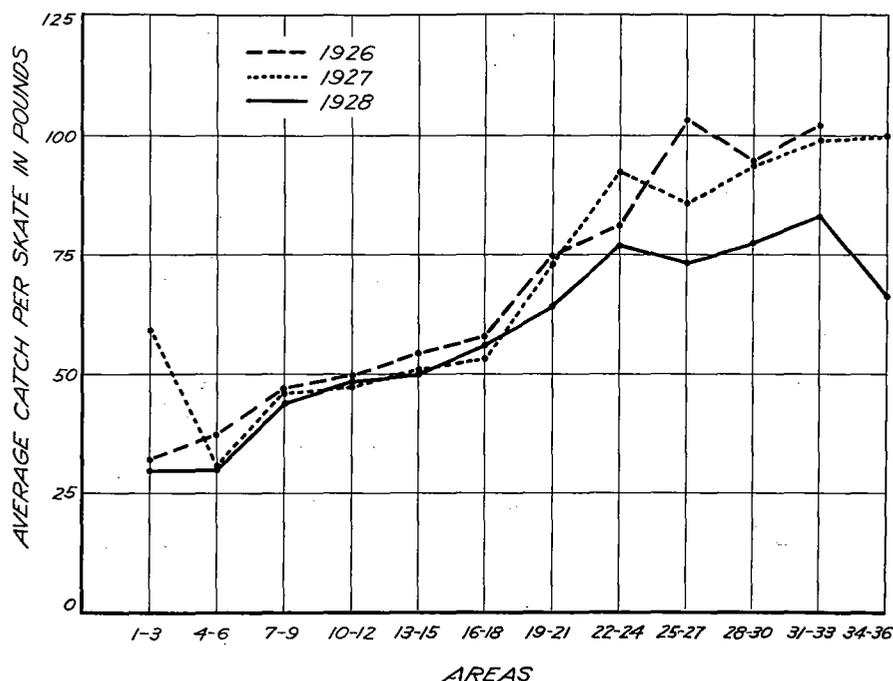


FIGURE 25.—Average weight caught per 6-line skate-set in 1926, 1927, and 1928, for groups of areas.

In Table 18 and Figure 25, the catch data for these three years are compared by groups of areas to remove the irregularities of Figure 24 and make comparison easier. No decided change in abundance can be seen as far north as Dixon Entrance, and it would seem probable that there the fishery is approaching the lowest possible level at which it can survive. Beyond Dixon Entrance, however, there is a considerable decline to Cape Spencer (15 to 17), a lesser one from Cape Spencer to Yakutat (18 to 20) and a great fall in all areas west of Yakutat. It is evident that the western banks are being rapidly depleted.

TABLE 18.—Catch per skate-set in various groups of areas in 1926, 1927, and 1928.

Groups of Areas	1926			1927			1928		
	Skates	Pounds	Average	Skates	Pounds	Average	Skates	Pounds	Average
1-3	629	19,492	31.0	735	43,127	58.7	3,147	92,639	29.4
4-6	3,351	122,999	36.7	1,323	39,808	30.1	7,965	235,883	29.6
7-9	5,954	275,685	46.3	5,308	241,866	45.6	15,681	684,534	43.7
10-12	48,379	2,378,469	49.2	33,902	1,607,783	47.4	55,726	2,645,624	47.5
13-15	69,167	3,730,770	53.9	38,062	1,937,451	50.9	57,588	2,871,136	49.9
16-18	26,152	1,494,636	57.2	12,811	679,618	53.0	22,994	1,273,886	55.4
19-21	25,047	1,863,735	74.4	25,617	1,867,317	72.9	43,112	2,734,103	63.4
22-24	15,177	1,299,109	85.6	13,901	1,277,722	91.9	25,302	1,937,369	76.6
25-27	70,456	7,202,418	102.2	43,659	3,748,994	85.9	78,826	5,752,153	73.0
28-30	42,850	4,026,119	94.0	35,622	3,324,415	93.3	43,106	3,320,267	77.0
31-33	7,932	807,885	101.9	7,971	788,682	98.9	11,479	947,634	82.6
34-36	73	4,750	65.1	951	94,750	99.6	733	47,900	65.3
Total	315,167	23,226,067	.....	219,862	15,651,533	.....	365,659	22,543,128	.....

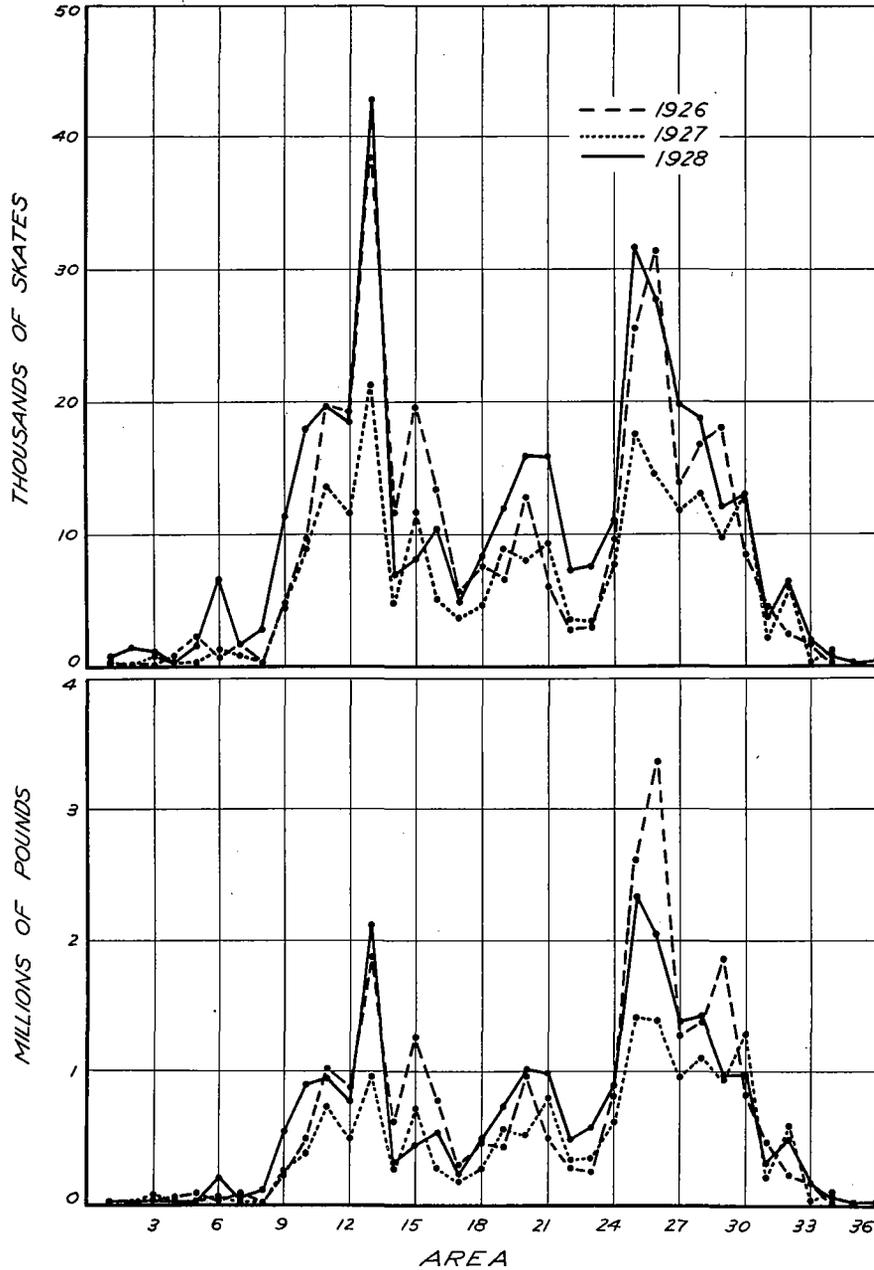


FIGURE 26.—Total skates fished and total weight caught in 1926, 1927, and 1928, both United States and Canadian.

The figures upon which are based the calculations as to average catch per skate in 1926, 1927, and 1928 in the various areas (Table 17 and Figure 26) represent accurately the catch per unit, but do not represent fairly the distribution of the intensity of fishing in the southern region. The logs were collected at Prince Rupert and in the various Alaskan ports. Seattle was canvassed once, but no continuous inquiry was made until 1929 when a great amount of 1928 data was obtained. The amount of gear used and the

total caught, as recorded in the logs at our command, therefore do not show the correct distribution for Seattle landings, since what is given is only from those of the Seattle boats which landed in Prince Rupert and hence are represented. Nor is it likely that any system depending upon voluntarily kept records will be complete. But the log records collected in 1926, 1927, and 1928 were obtained from practically the same portion of the northern fleet, represent the whole fleet approximately, and can be used comparatively to detect any great changes of intensity that may have occurred north of Dixon Entrance during these years.

In Table 17 the distribution of gear-sets and weight of catch is given, and in Figure 26 this is represented graphically. There is plain evidence of the concentration of the catches in three main areas, Hecate Strait (areas 11 to 13), the Yakutat region (areas 19 to 21), and the banks between Portlock and Trinity (areas 25 to 30). The catch taken from Portlock is very great, a conclusion that will be corroborated later.

TABLE 19.—Percentage of the total skate-sets in 1926, 1927, and 1928, which were made in each statistical area.

Area	1926	1927	1928
1	.10	.02	.22
2	.....	.01	.36
3	.10	.31	.28
4	.24	.02	.03
5	.64	.12	.39
6	.18	.46	1.75
7	.49	.31	.44
8	.03	.06	.76
9	1.37	2.04	3.09
10	3.12	4.04	4.87
11	6.16	6.23	5.38
12	6.07	5.15	4.99
13	12.19	9.97	11.74
14	3.59	2.13	1.82
15	6.17	5.21	2.19
16	4.25	2.23	2.80
17	1.73	1.62	1.24
18	2.32	1.98	2.24
19	2.01	3.94	3.28
20	4.09	3.56	4.26
21	1.85	4.15	4.25
22	.87	1.51	1.94
23	.93	1.45	1.98
24	3.01	3.36	3.01
25	8.05	7.88	8.63
26	9.92	6.66	7.53
27	4.39	5.32	5.40
28	5.30	5.89	5.08
29	5.71	4.44	3.29
30	2.58	5.87	3.41
31	1.30	.95	.95
32	.76	2.60	1.72
33	.46	.08	.47
34	.02	.43	.16
35	.....	.....	.01
36	.....	.....	.04
Total	100.00	100.00	100.00

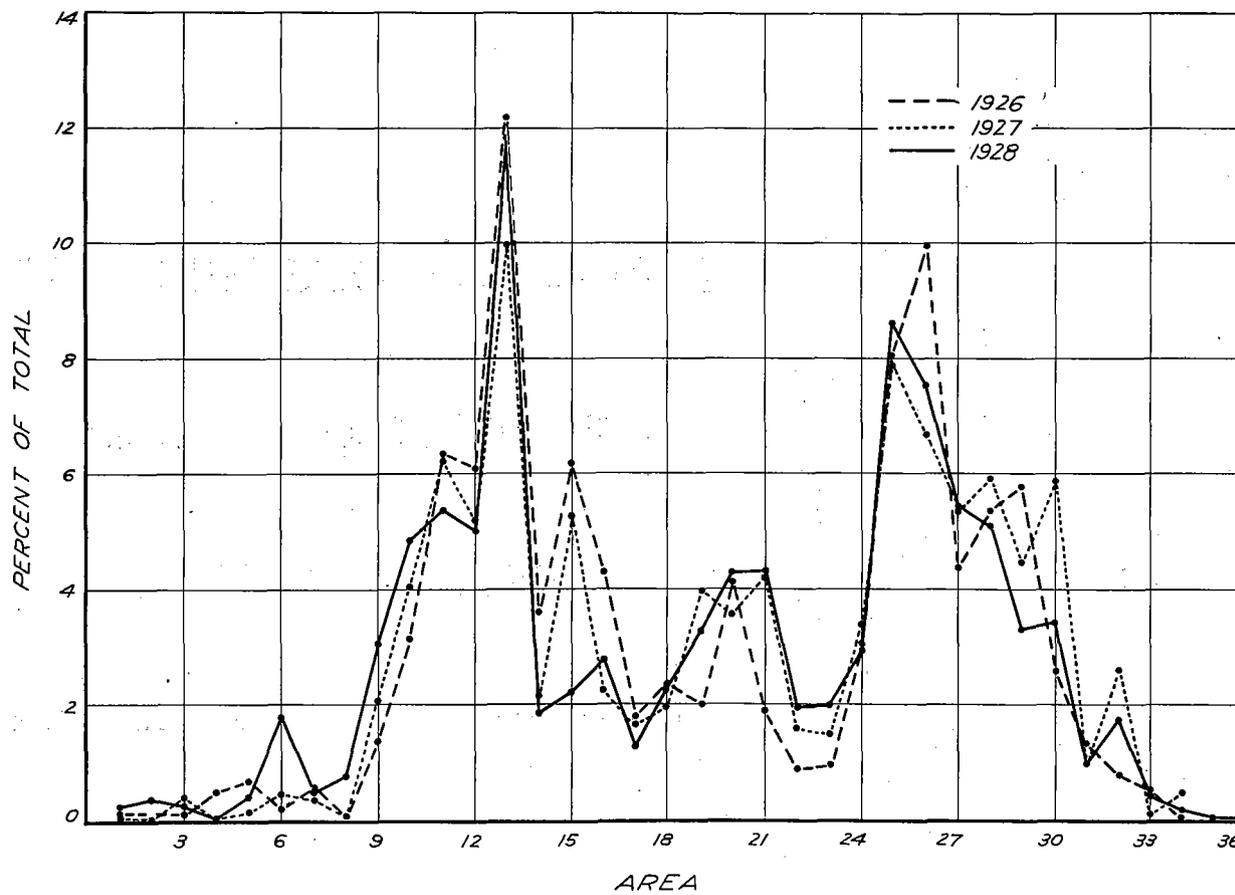


FIGURE 27.—Percentage of total number of skates fished on Pacific Coast, given for each area during 1926, 1927, and 1928.

Since the total varies in the different years, it is somewhat difficult to decide from Table 17 and Figure 26 the relative amount of fishing in the various regions as shown by our log records of 1926, 1927, and 1928, and to facilitate this comparison, the actual data as to number of skate-sets given in Table 17 are reduced in Table 19 to a percentage basis, and are shown graphically in this form in Figure 27. A decided reduction in the intensity of fishing in Southeastern Alaska and Hecate Strait (areas 12 to 16 inclusive) is indicated, with a corresponding increase between the Fair-weather and Cape Cleare Grounds (areas 19 to 24). This is in agreement with information obtained from other sources. Part of the fleet, composed of small but seaworthy vessels which previously fished largely between Dixon Entrance and Cape Spencer, have shifted to the grounds north of Cape Spencer for at least part of the year, due to the fall in abundance shown in Figure 16 for the first region.

There seems also to be a reduction on Portlock Bank (area 26) but whether this or others are due to chance variability cannot well be determined here. However, certain other series of data (in manuscript) indicate such a tendency.

SECTION 3: SEASONAL ANALYSIS

SEASONAL FLUCTUATIONS IN ABUNDANCE AND IN INTENSITY OF FISHING

From the standpoint of seasonal fluctuations in abundance and in the intensity of the fishery, the records are both interesting and instructive. Analysis shows that these are so consistent from year to year for the different sections of the coast that there can be no doubt as to their reality. They occur in the catch per set of a standard 6-line skate of gear. This catch may reflect the manner in which the fish take bait and the concentration of the schools for such purposes as spawning, and its fluctuations may be changes in actual abundance. Nevertheless, in conformity with usage, the term abundance is used here as more convenient and because in comparing the averages for successive years seasonal changes must be assumed to repeat themselves annually and are for the time being ignored, so that the catch per unit is accepted as a direct measure of abundance.

This so-called abundance is but one of several factors determining the amount of gear set during the different months. Weather and price are even more important. For this reason the tables show also the amount of gear run, and the changes in this with the season are indicated in graphs comparing the percentage of the year's total run each month. Because the seasonal maximum of gear run coincides sometimes with a high and sometimes with a low level of abundance, the seasonal fluctuations in abundance and seasonal changes in intensity affect to some extent the yearly averages of catch per unit in the different regions which have been dealt with in the preceding section. These seasonal changes must therefore be considered in order to prove that the declines shown in the historical section are not due to changes in the fishery. Moreover, it is only by a seasonal analysis of the amount of gear used that the effect of the closed season on the fishery of each region can be determined, or that of any future regulation can be judged.

For purposes of analysis the statistical areas were combined in groups of considerable size, corresponding very well to natural divisions of the fleet. The groups considered are 1 to 8, 9 to 13, 14 to 18, 19 to 23, 24 to 28, and 29 to 36, the same as have been employed elsewhere in this report. Since the data available for all but 1926, 1927, and 1928 were not very numerous when divided between the different sections enumerated above, it also seemed advisable to group the years. The groups of years are not always the same, the number included in a group being dependent on the number of records available in the different years for each region under consideration. Where the amount of data warrants it, 1926, 1927, and 1928 are also analyzed separately.

SEASONAL CHANGES IN AREAS 1 TO 8

In Table 20 are given the number of 6-line skate-sets in areas 1 to 8, the catch in pounds, and the calculated average catch per skate-set by months for the years 1915 to 1920, 1921 to 1925, and 1926 to 1928, all inclusive. The average catches are plotted in Figure 28 for the three periods. Because of insufficient data to give reliable averages, March, July, August, November, and December of 1915 to 1920; February of 1921 to 1925; and February and November of 1926 to 1928 are omitted.

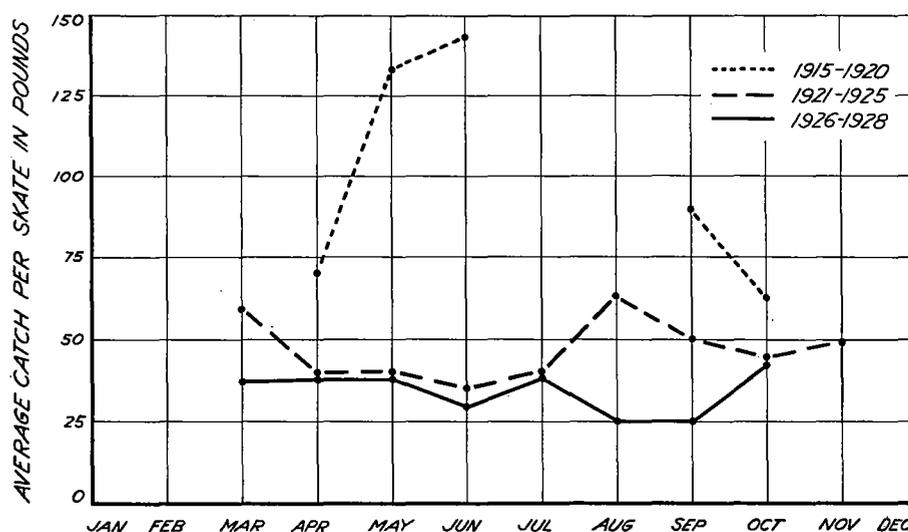


FIGURE 28.—Seasonal change in average weight caught per 6-line skate-set in areas 1 to 8, by groups of years from 1915 to 1928. Data for March, July, August, November, and December for 1915 to 1920, omitted because insufficient.

It is evident from the table that this fishery has been confined to spring, summer, and fall, with most of the fishing done in the spring and fall within the period for which we have records. That the fishery would be confined to these seasons is to be expected, since with the exception of 1915 and 1916, it has been conducted almost entirely by small boats. Due to the severity of the weather and lack of accessible harbors in most of this region, the small boats either stop operations in the winter months or move to more sheltered grounds. The amount of data available for this region is so small as to render any seasonal analysis of intensity untrustworthy.

TABLE 20.—Number of sets of 6-line skates, total catch in pounds, and average catch per skate in areas 1 to 8 by months and groups of years from 1915 to 1928.

Year		Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Total
1915-20	Skates	.....	.....	63	1,582	1,984	1,019	9	78	477	255	90	8	5,565
	Pounds	.....	.....	1,145	111,250	262,950	146,100	350	3,000	42,450	16,110	2,315	200	585,870
	Average	.....	.....	18	70	133	143	39	38	89	63	26	25	105
1921-25	Skates	.....	223	2,260	2,259	1,454	1,734	1,361	1,357	1,829	3,161	909	.....	16,547
	Pounds	.....	8,500	132,850	90,650	58,580	61,000	55,000	85,500	91,850	140,449	44,800	.....	769,179
	Average	.....	38	59	40	40	35	40	63	50	44	49	.....	47
1926-28	Skates	.....	644	1,479	2,344	3,645	4,049	2,292	2,337	3,528	3,179	491	.....	23,988
	Pounds	.....	13,165	54,617	88,015	137,650	116,074	87,571	58,170	89,314	132,679	22,000	.....	799,255
	Average	.....	20	37	38	38	29	38	25	25	42	45	.....	33

No special significance can be attached to the seasonal fluctuations shown by the 1915 to 1920 average catches. The summer fishery in 1915 and 1916 on the newly discovered banks off Oregon has so much weight (Appendix A) as to make the May and June averages non-representative of the period as a whole.

From 1921 to 1928, as indicated by the 1921 to 1925 and 1926 to 1928 data, the abundance of halibut has been in general very low throughout the entire fishing season, with no great fluctuations. The fact of this low level since 1921 is perhaps the only valid conclusion which can be drawn from the sparse data, but its consistency throughout the season in both periods shown should prove its accuracy. The averages for August and September of 1921 to 1925 must be disregarded as they are dependent mostly on the records of one year—1921, the year of greatest abundance in the group—and cannot be considered representative. The greater abundance in March and November of 1921 to 1925 and October of 1926 to 1928 probably indicates the schooling of a few mature fish for the spawning season. The absence of a winter fishery before the closed season shows the futility of the latter as a protective measure on these banks.

SEASONAL CHANGES IN AREAS 9 TO 13

Table 21 gives the number of sets of 6-line skates in areas 9 to 13, the part of the coast lying between the north end of Vancouver Island and Dixon Entrance, the catch in pounds, and the calculated average catch per skate by months for various groups of years—1913 to 1916, 1917 to 1919, 1920 to 1922, 1923 to 1925, and 1926 to 1928. The average monthly catches for each of these periods are plotted in Figure 29, upper. The catches for November and December of 1917 to 1919 are omitted because the small amount of data makes these averages unreliable. The trends of the average catches of the different periods are very similar and the decline shown for each season from the early to the late years is in general agreement with that shown on page 74 and in Figure 13 for the successive yearly averages as a whole.

The trends for all periods show a relatively high level of abundance in winter and summer with a low level in spring and fall. The catch is high in January and February, falls off to a very low figure in March or April, increases to July or August, falls off again to October or November, and then rises abruptly. The high level of abundance in winter is correlated with the concentration of the fishery on schools of mature fish on the outer coast banks during the spawning season. The presence of spawners in considerable numbers is indicated by the January and February catches in the earlier years. That these have been largely fished off is also plainly indicated by the changes in January and February before the closed season and the present low level of abundance in November and February, despite the lack of records from the middle of November to the middle of February since the inauguration of the closed season.

TABLE 21.—Number of sets of 6-line skates, total catch in pounds, and average catch per skate in areas 9 to 13 by months and groups of years from 1913 to 1928, showing percentage by months of total gear-sets made.

Year		Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Total
1913-16	Skates	855	1,401	2,997	2,714	5,784	7,168	8,717	7,042	5,522	3,279	1,204	489	47,172
	Pounds	110,415	162,900	231,400	297,100	909,300	990,500	985,200	977,166	523,716	216,267	57,600	38,000	5,499,564
	Average	129	116	77	109	157	138	113	139	95	66	48	78	117
	Percentage	1.8	3.0	6.4	5.8	12.3	15.2	18.5	14.9	11.7	6.9	2.6	1.0	.....
1917-19	Skates	878	1,028	1,631	2,556	2,983	4,565	4,573	6,283	2,798	857	10	58	28,220
	Pounds	164,635	153,395	91,690	163,670	222,770	327,780	401,418	546,787	227,315	66,550	150	11,000	2,377,160
	Average	187	149	56	64	75	72	88	87	81	78	15	190	89
	Percentage	3.1	3.6	5.8	9.1	10.6	16.2	16.2	22.3	9.9	3.0	.04	.2	.....
1920-22	Skates	452	1,793	2,049	2,226	3,423	5,923	7,402	10,104	6,686	774	370	.....	41,202
	Pounds	49,450	148,506	124,680	116,875	251,230	457,982	579,570	777,118	539,570	41,140	29,850	.....	3,115,971
	Average	109	83	61	53	73	77	78	77	81	53	81	.....	76
	Percentage	1.1	4.4	5.0	5.4	8.3	14.4	18.0	24.6	16.2	1.9	.7	.....	.....
1923-25	Skates	415	1,425	5,221	5,376	10,883	11,543	11,091	13,823	6,009	1,981	434	.....	68,201
	Pounds	30,900	99,935	273,595	238,904	565,260	607,620	630,347	865,600	355,575	93,323	18,210	.....	3,779,269
	Average	74	70	52	44	52	53	57	63	59	47	42	.....	55
	Percentage	.6	2.1	7.7	7.9	16.0	16.9	16.3	20.3	8.8	2.9	.6	.....	.....
1926-28	Skates	.....	8,254	29,473	36,615	36,668	42,972	40,338	33,516	19,191	11,114	3,244	.....	261,385
	Pounds	.....	411,470	1,346,844	1,579,486	1,608,625	2,195,392	2,195,326	1,705,001	907,995	462,705	155,005	.....	12,567,849
	Average	.....	50	46	43	44	51	54	51	47	42	48	.....	48
	Percentage	.....	3.2	11.3	14.0	14.0	16.5	15.4	12.8	7.4	4.3	1.2	.....	.....

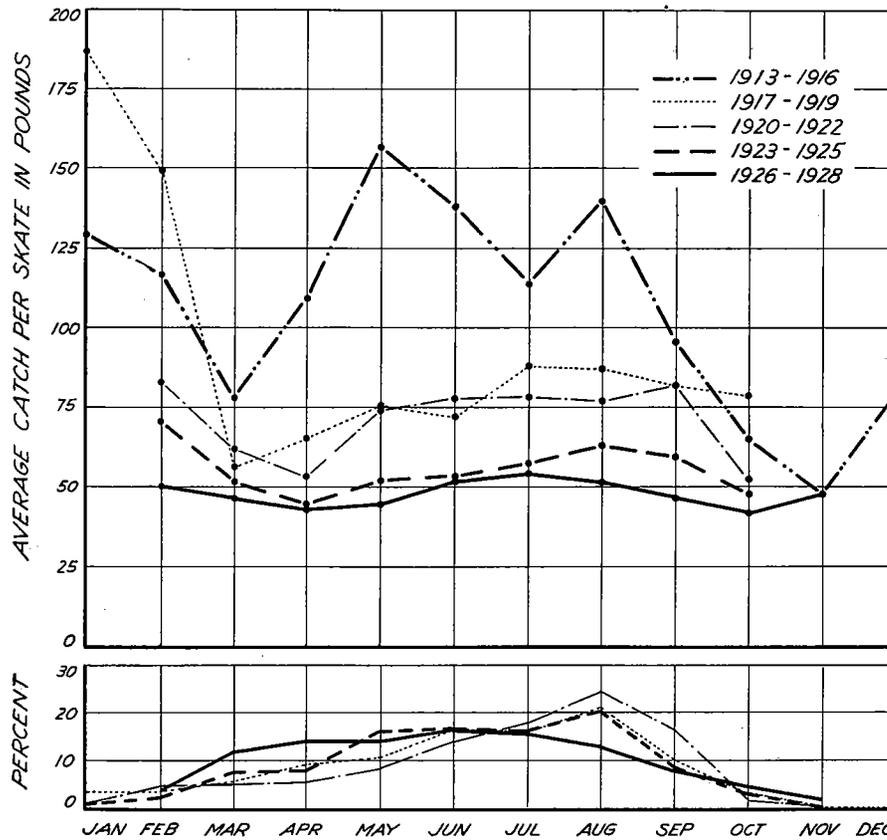


FIGURE 29.—Seasonal change in average catch per unit and amount of gear run in areas 9 to 13 by groups of years from 1913 to 1928. Upper—Average catch per 6-line skate-set. Lower—Percentage by months of total gear-sets made.

The high catches in summer are correlated with the concentration of the fishery on the shallower inshore banks where the fish are feeding actively. As would be expected, the two seasonal maxima of feeding and of spawning were pronounced in the early years while spawning fish were present in numbers but became less noticeable as depletion proceeded.

In Table 22 and Figure 30 the average monthly catch per skate-set in the same region is shown for 1926, 1927, and 1928 separately. There is a notable consistency in the records of the three years, and there cannot be any doubt as to their correctness. June, July, and August are the months of greatest abundance, and it is during the same period that the monthly production for this group of areas reaches its maximum.

In each year there is an indication of the abundance being greater in the first months of the year than in April and May, but only 1928 shows it unmistakably. This trend is also shown in Figure 29, upper, where the weighted monthly averages for the three combined years are shown in comparison with earlier years where it is much more pronounced. This

TABLE 22.—Number of sets of 6-line skates, total catch in pounds, and average catch per skate in areas 9 to 13, for 1926, 1927, and 1928.

Month	1926			1927			1928		
	Skates	Pounds	Average	Skates	Pounds	Average	Skates	Pounds	Average
Feb.	2,272	104,965	46.2	1,223	47,495	38.8	4,759	259,010	59.4
Mar.	14,670	695,090	47.4	6,480	278,841	43.0	8,323	372,913	44.8
Apr.	14,442	617,460	42.8	8,568	315,621	36.8	13,605	646,405	47.5
May	12,217	538,531	44.1	9,110	366,930	40.3	15,341	703,164	45.8
June	14,791	831,095	56.2	10,031	480,360	47.9	18,150	883,937	48.7
July	14,873	801,949	53.9	9,338	473,406	50.7	16,127	919,971	57.0
Aug.	9,118	466,404	51.2	7,097	393,202	55.4	17,299	845,395	48.9
Sept.	5,552	255,195	46.0	4,804	270,820	56.4	8,835	381,980	43.2
Oct.	2,145	109,720	45.4	2,687	137,000	51.0	6,012	215,985	35.9
Nov.	774	34,810	45.0	951	44,475	46.8	1,521	75,720	49.8
Total	91,124	4,455,219	.....	60,289	2,808,150	.....	109,972	5,304,480	.....

phenomenon, reappearing in our data in 1928, is due to the exploitation of small spawning schools found adjacent to the outside coasts of the Queen Charlotte Islands. For the same reason a decided increase occurs in November of 1928 from the low level of October.

The difference between the fishery in the inside and outside waters of this region is shown in Table 23 and Figure 31, where a seasonal analysis of the average catch per skate for areas 11, 12, and 13 is shown. Areas

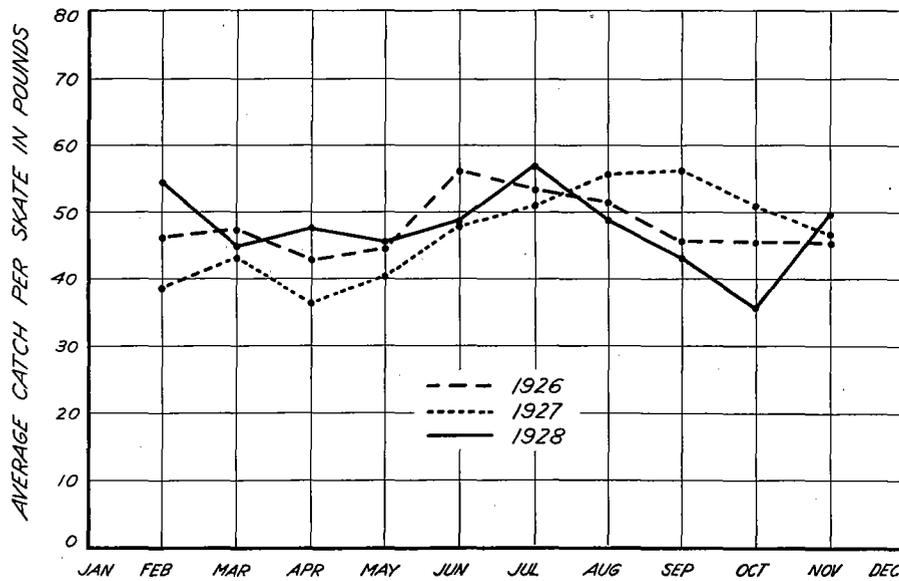


FIGURE 30.—Seasonal change in catch per 6-line skate-set in areas 9 to 13 for 1926, 1927, and 1928.

TABLE 23.—Number of sets of 6-line skates, total catch in pounds, and average catch per skate on the outer coast of the Queen Charlotte Islands and inner, or Hecate Strait Banks, of areas 11 to 13 for 1926, 1927, and 1928, giving percentage for each month of total gear fished in each region.

Locality	Month	1926			1927			1928			1926 to 1928			
		Skates	Pounds	Average	Skates	Pounds	Average	Skates	Pounds	Average	Skates	Pounds	Average	Percent of Gear
West Coast of Queen Charlotte Islands	Feb.	468	29,350	62.7	248	15,850	63.9	1,055	78,850	74.7	1,771	124,050	70.0	6.2
	Mar.	1,290	90,855	70.4	861	51,273	59.6	1,369	88,660	64.8	3,520	230,788	65.6	12.3
	Apr.	898	71,100	79.2	1,471	77,150	52.4	2,034	138,750	68.2	4,403	287,000	65.2	15.4
	May	1,482	118,850	80.2	2,344	118,550	50.6	2,211	127,700	57.8	6,037	365,100	60.5	21.1
	June	1,802	138,760	77.0	1,542	85,750	55.6	1,110	50,211	45.2	4,454	274,721	61.7	15.6
	July	2,159	129,150	59.8	466	27,400	58.8	585	25,550	43.7	3,210	182,100	56.7	11.2
	Aug.	445	28,500	64.0	200	14,450	72.3	477	21,875	45.9	1,122	64,825	57.8	3.9
	Sept.	710	51,840	73.0	289	17,050	59.0	213	12,250	57.5	1,212	81,140	66.9	4.2
	Oct.	409	14,650	35.8	386	24,815	64.3	814	28,940	35.6	1,609	68,405	42.5	5.6
	Nov.	223	16,700	74.9	229	18,025	78.7	777	53,500	68.9	1,229	88,225	71.8	4.3
	Total		9,886	689,755	69.8	8,036	450,313	56.0	10,645	626,286	58.8	28,567	1,766,354	61.8	99.8
Hecate Strait	Feb.	878	29,725	33.9	659	20,095	30.5	1,882	82,410	43.8	3,419	132,230	38.7	2.4
	Mar.	7,595	320,575	42.2	3,581	144,670	40.4	3,679	130,715	35.5	14,855	595,960	40.1	10.4
	Apr.	9,550	366,760	38.4	4,791	161,375	33.7	7,693	308,055	40.0	22,034	836,190	37.9	15.4
	May	8,926	347,800	39.0	4,980	177,880	35.7	9,077	367,053	40.4	22,983	892,733	38.9	16.1
	June	9,598	500,095	52.2	5,780	263,010	45.5	10,824	522,495	48.3	26,202	1,285,600	49.1	18.3
	July	6,879	371,839	54.0	5,585	289,111	51.8	11,112	555,884	50.0	23,576	1,216,334	51.6	16.5
	Aug.	5,536	300,624	54.3	4,590	268,559	58.5	8,976	428,825	47.8	19,102	998,008	52.2	13.4
	Sept.	2,594	119,140	45.9	2,420	146,350	60.5	3,719	140,585	37.8	8,733	406,075	46.5	6.1
	Oct.	414	14,250	34.4	815	41,175	50.5	568	21,620	38.1	1,797	77,045	42.9	1.3
	Nov.	23	260	11.3	95	2,000	21.1	24	700	29.2	142	2,960	20.8	0.1
	Total		51,993	2,370,568	45.6	36,296	1,514,225	45.5	57,554	2,558,342	44.5	142,843	6,443,135	45.1	100.0

9 and 10, having no such contrasting inner and outer grounds, are omitted. The areas considered have been divided into two sections, one for the outer coast and the other for the inner or Hecate Strait Grounds. The Canadian fleet of small boats uses both areas without much admixture of United States vessels as far as our data are concerned, and since our canvass of the Canadian fleet is very representative, the data will bear careful analysis. Due to the relatively light fishery on the outer coasts, the three years 1926, 1927, and 1928 are combined in the graph of Figure 31, upper. These are contrasted with similar data for Hecate Strait presented each year separately.

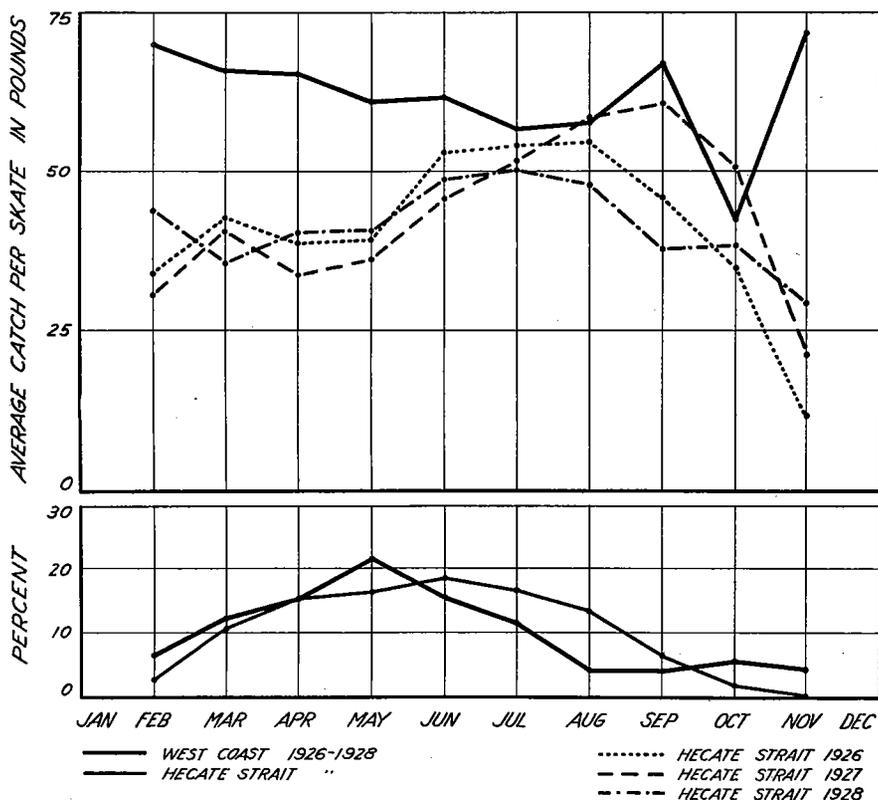


FIGURE 31.—Seasonal change in average catch per unit and in amount of gear run on inner and outer grounds of areas 11, 12, and 13. Upper—Average catch per 6-line skate-set by months in Hecate Strait for 1926, 1927, and 1928 separately, contrasted with same for West Coast of Queen Charlotte Islands for the same years combined. Lower—Percentage for each month of total gear fished in each region.

The inside waters of Hecate Strait show a lower level of abundance in accord with their greater accessibility and the resultant economic saving in their use. The maximum amount per skate-set is taken in June, July, and August. Abundance is at a decidedly lower level in the earlier and later months. In the outside waters, as shown by the combination of three years, there is a decline in catch per unit throughout the year from the high level of late winter, with an increase in November.

The poor catches made in these inner waters in spring and fall are difficult to explain. But the most probable explanation is undoubtedly that the catches of immature fish which predominate on these inner grounds are affected mainly by seasonal changes in feeding, leading to variability in manner of taking bait. There seems to be no noticeable winter concentration for spawning on these inner grounds, even mature fish being largely absent, especially during the winter season when the average size taken is largest. The seasonal change in physical conditions is a maximum in such inclosed and shoaler waters and may result in a near cessation of feeding during winter, thus leaving maximal catches in late summer, entirely aside from any migration of mature fish which may occur.

In deeper outer waters with more uniform conditions this variation may not be so great and some feeding undoubtedly does take place all year. At all events on the outer banks the concentration of mature fish in spring and fall for spawning must favor better catches and must be sufficient to more than balance whatever change in feeding habits occurs. Hence, perhaps, the contrast between the seasonal abundance on inner and outer banks.

The fishery has been almost entirely a seasonal one, ceasing almost completely in winter even before the legal winter closed season from November 16 to February 15 became effective. In Table 21 the amount of gear fished each month in areas 9 to 13 inclusive, is given, and is shown graphically in Figure 29, lower, in terms of the percentage of the total for each group of years, thus contrasting the seasonal distribution more effectively. From 1917 to 1925 the climax of the fishery was reached in August. But in the period 1926 to 1928 the fishery rose quickly in early spring, reached a poorly marked climax in June, and fell gradually to November. In recent years it is apparent that a more uniform effort was made throughout the whole season, as though every opportunity was made use of. It is, of course, a temptation to ascribe such changes to the economic effects of the winter closure. But as such a change might easily be assigned to better prices in spring, to a harder struggle for existence, or to changes in movements of the fleet, detailed analysis of causes must await studies of these matters. For the present the main conclusion to be drawn is that the fishery is and has been since 1917 highly seasonal, falling to almost nothing in the months November to February inclusive. The principal effect of the winter closure during these months must therefore be the indirect economic ones resultant from restriction applied to competing vessels on other banks.

This is, however, not wholly the case. As has been mentioned, in early years there was a winter fishery, with high yield per unit. This was undoubtedly for spawning fish, although unfortunately the data previous to 1926 cannot be as readily analyzed as those for recent years. In Table 23 the numbers of skate-sets made in Hecate Strait and on the outer coast of the Queen Charlottes are shown for each month of the period 1926 to 1928 inclusive. The total number run in Hecate Strait was 142,843, on

the West Coast of the Queen Charlottes 28,567, the former fishery being therefore five times as great as the latter. Comparison of the seasonal changes from the table is somewhat difficult because of the variations between the three seasons and between the magnitude of the fishery in the two districts of the areas considered. For these reasons the skate-sets made in three seasons have been combined for each district, and the percentage of the total which was run in each month is shown in Figure 31, lower. In comparing the two graphs it must be remembered that that for Hecate Strait represents five times the amount of gear that the other does.

It will be observed that the fishery on the outer coast is relatively heavy in February to May, lighter in June to September, and heavier in October and November. This is in accord with what would be expected from the relative catch per skate during the different months as shown in Figure 31, upper, with some allowance for the need of a higher general level of abundance on the more distant and more exposed outer banks. We may therefore conclude that the fishery on the outer coasts of these southern areas has a strong tendency to persist into the winter season, which we believe is due to the presence there of mature fish. If so, the closed season, although it applies to a relatively very small fishery, does to a certain extent protect the almost vanished spawners on the southern grounds and may permit their replenishment in course of time if made extensive enough.

SEASONAL CHANGES IN AREAS 14 TO 18

The seasonal analysis for areas 14 to 18, Southeastern Alaska, is given in Table 24, by groups of years—1914 to 1919, 1920 to 1922, 1923 to 1925, and 1926 to 1928. The years 1914 to 1919 are represented in our records by very few boats fishing in these areas and only February, March, and April can be considered reliable as regards average catch. As far as the distribution of the fishing effort during these earlier years is concerned our data are too few for use. The average catch per 6-line skate by months is plotted for the various groups of years in Figure 32. Because of the unreliability of the average catches, January and May to November of 1914 to 1919 and December of 1920 to 1922 have been omitted. The data for the latest three groups of years agree very well as to trend. Winter is the season of greatest abundance. The catch falls off rapidly at first and then slowly throughout the spring and summer to late fall when it rises again. The slope of the curve for the three reliable months of the period 1914 to 1919 agrees with that of the other periods for the same season, and indicates the higher level of abundance during those years. The decline shown in Figure 16, where the average yearly catches are compared, agrees well with the decline shown here for each season.

TABLE 24.—Number of sets of 6-line skates, total catch in pounds, and average catch per skate in areas 14 to 18 by months and groups of years from 1914 to 1928, giving percentage for each month of total gear run in each group of years.

Year		Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Total
1914-19	Skates	488	1,000	1,047	1,442	173	383	332	44	382	383	316	.....	5,990
	Pounds	74,016	128,787	122,870	132,383	17,401	51,000	20,600	5,600	60,200	50,678	32,000	.....	695,535
	Average	152	129	117	92	101	133	62	127	158	132	101	.....	116
	Percentage	8.1	16.7	17.5	24.1	2.9	6.4	5.5	.7	6.4	6.4	5.3	.....	.....
1920-22	Skates	886	1,620	1,682	2,104	1,808	1,700	3,129	2,854	3,591	2,751	913	149	23,187
	Pounds	73,675	121,785	140,299	164,393	110,450	111,576	198,922	181,764	257,057	148,290	58,408	45,950	1,612,569
	Average	83	75	83	78	61	66	64	64	72	54	64	308	70
	Percentage	3.8	7.0	7.3	9.1	7.8	7.3	13.5	12.3	15.5	11.9	3.9	.6	.....
1923-25	Skates	1,129	3,437	3,831	3,481	3,474	3,211	5,575	4,726	3,026	3,153	569	.....	35,612
	Pounds	124,800	241,924	251,432	210,085	216,262	183,201	318,985	252,573	138,670	157,622	33,170	.....	2,128,724
	Average	111	70	66	60	62	57	57	53	46	50	58	.....	60
	Percentage	3.2	9.6	10.7	9.8	9.7	9.0	15.6	13.3	8.5	8.9	1.6	.....	.....
1926-28	Skates	.....	9,075	14,820	17,992	15,819	19,077	14,077	14,050	10,233	6,201	2,158	.....	123,502
	Pounds	.....	591,926	823,434	1,069,673	933,313	1,011,016	801,750	784,166	545,926	307,928	139,170	.....	7,008,302
	Average	.....	65	56	59	59	53	57	56	53	50	64	.....	57
	Percentage	.....	7.3	12.0	14.5	12.8	15.4	11.4	11.4	8.3	5.0	1.7	.....	.....

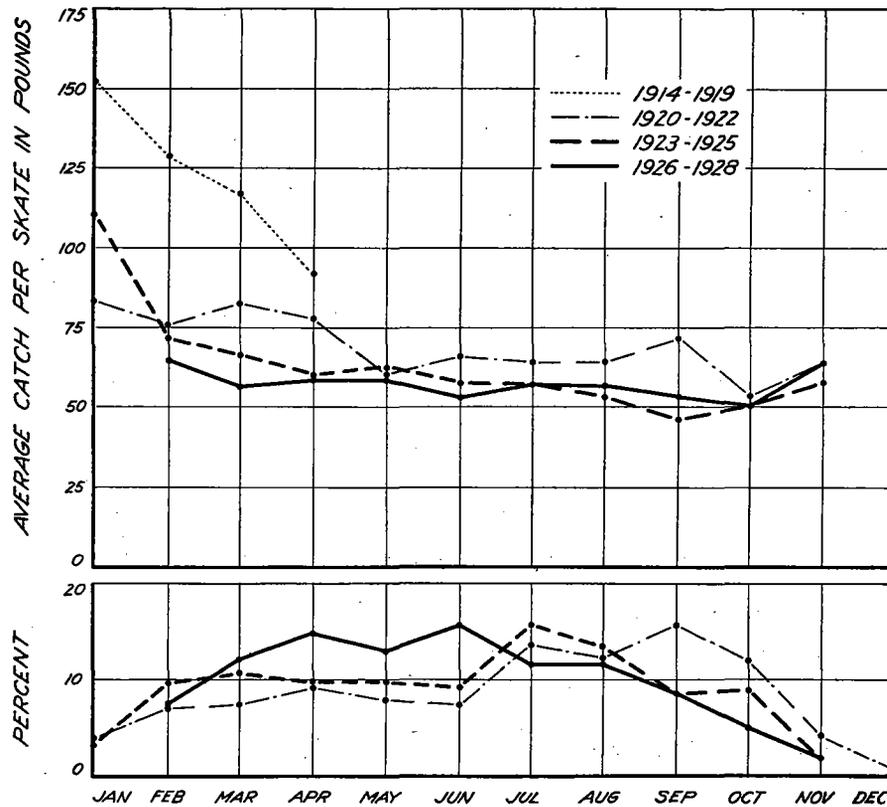


FIGURE 32.—Seasonal change in average catch per unit and in amount of gear run in areas 14 to 18, by groups of years from 1914 to 1928. Upper—Average catch per 6-line skate-set by months. Lower—Percentage for each month of total gear run in each group of years.

The 1926, 1927, and 1928 data are analyzed separately in Table 25, and the averages for each year are plotted in Figure 33. A general agreement as to the seasonal fluctuations in abundance is shown by the three curves. In both spring and fall of 1928 unusually large catches are indicated, though the catches in general for the three years show a decline from year to year. It is not known what significance, if any, can be attached to the increased abundance shown for February and November of 1928, because these increases accompany a very considerable variability from month to month.

The trend of the seasonal curves is, in its higher level during the spring months, very similar to that for the outer coast of the Queen Charlotte Islands, areas 11 to 13, and differs accordingly from that for the group 9 to 13 as a whole. In areas 14 to 18 the fishery is carried on partly in the numerous channels, partly on the much broken outer coast where the fishing banks are in places wide, in places narrow. No inner strait or channel exists there which is fairly comparable to Hecate Strait, and no sharp division of the fishery can be made as has been done for areas 11 to 13 since such a division would necessarily be between different parts

TABLE 25.—Number of sets of 6-line skates, total catch in pounds, and average catch per skate in areas 14 to 18 for 1926, 1927, and 1928.

Month	1926			1927			1928		
	Skates	Pounds	Average	Skates	Pounds	Average	Skates	Pounds	Average
Feb.	5,366	328,175	61.2	1,536	98,551	64.2	2,173	165,200	76.0
Mar.	8,027	431,864	53.8	3,260	166,740	51.1	3,533	224,830	63.6
Apr.	8,522	539,230	63.3	4,715	280,350	59.5	4,755	250,093	52.6
May	6,566	391,622	59.6	4,876	278,591	57.1	4,377	263,100	60.1
June	9,045	492,605	54.5	4,540	271,450	59.8	5,492	246,961	45.0
July	5,963	346,700	58.1	4,122	258,200	62.6	3,992	196,850	49.3
Aug.	6,824	433,040	63.5	2,670	117,076	43.8	4,556	234,050	51.4
Sept.	4,565	296,695	65.0	1,462	67,270	46.0	4,206	181,961	43.3
Oct.	1,413	61,075	43.2	1,438	79,850	55.5	3,350	167,003	49.9
Nov.	608	36,930	60.7	344	17,017	49.5	1,206	85,223	70.7
Total	56,899	3,357,936	.....	28,963	1,635,095	.....	37,640	2,015,271	.....

of the outer banks. But a separation of that carried on inside the channels rather than on the coastal banks in 1929³ indicates that 64 per cent of the total catch is taken on the banks of the outer coast. The latter therefore dominates, and to this fact may possibly be ascribed the resemblances of the seasonal trend in catch per unit to that of the outer coast of areas 11 to 13.

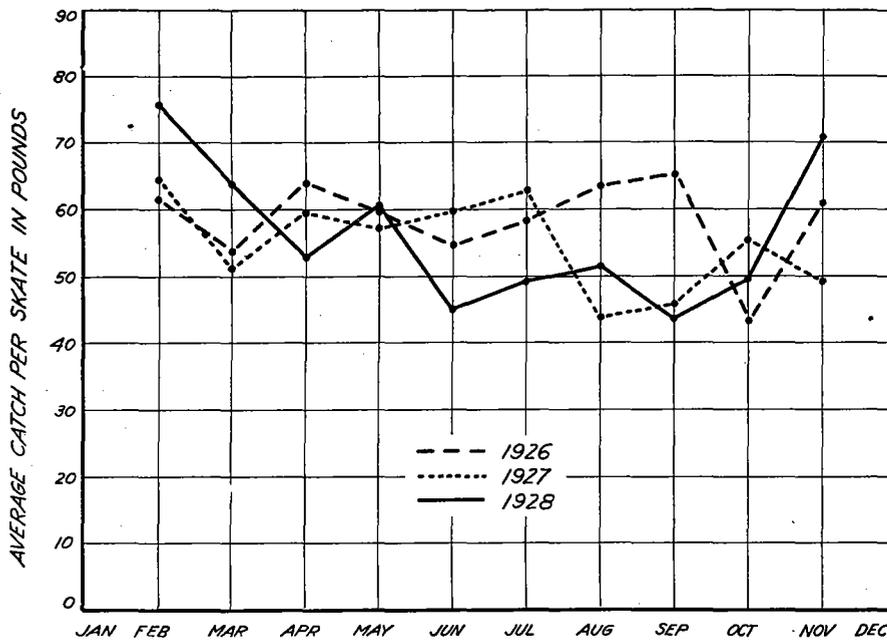


FIGURE 33.—Seasonal change in weight caught per 6-line skate-set in areas 14 to 18 for 1926, 1927, and 1928.

³ From manuscript data by F. Heward Bell.

The number of skate-sets made month by month for the several groups of years is given in Table 24 and shown graphically in Figure 32, lower. That for the years 1914 to 1919 is omitted because the scarcity of vessels in our records makes it unreliable. From 1920 to 1925 inclusive, the seasonal maximum is late; July, August, or even September. But in the period 1926 to 1928, this maximum is in June, with a more symmetrical and even distribution. The same changes in the season of the fishery has occurred as in areas 9 to 13, and this change must therefore be regarded as a significant one, common to two entirely separate fleets, those of Canada and those of the United States in Southeastern Alaska. The connection must, it would seem, be an economic one, either better prices and market in early summer, or a necessity for more continuous labor. Since the salmon fishery seasonally draws many vessels away from the halibut fishery the matter becomes a rather complicated one for analysis, and before assigning the change to any one factor, such as closure of the winter season in 1924 to 1925, further information must be secured.

There is no reason to doubt but that the closed season has affected the fishing in these regions indirectly, through changes in competition, prices, and markets, but direct curtailment of the catch in these areas has been slight. The fishery has been conducted principally in the spring, summer, and fall from 1920 to 1928. From 1920 to 1922, shortly before the closed season, 15½ per cent of the year's fishing was done from November to February inclusive. In 1926 to 1928 about 9 per cent occurred in the first half of November and the last half of February. This would mean that, allowing for changes in total, about 7½ per cent of the year's fishing was eliminated by the closed season. Here, as in areas 9 to 13, it would seem that the closed season has eliminated very little fishing that was normally done before it was established and that it offers little protection to the stock on these grounds.

SEASONAL CHANGES IN AREAS 19 TO 23

The log records of fishing for areas 19 to 23, from 1913 to 1928, are summarized in Table 26. The number of sets in terms of 6-line skates, the catch in pounds, and the calculated average catch per skate are given by months for different groups of years—1913 to 1916, 1917 to 1919, 1920 to 1922, 1923 to 1925, and 1926 to 1928. The data for the earliest period are not so numerous as for the more recent ones but are still sufficient to indicate the seasonal fluctuations in abundance and the seasonal nature of the fishery. No data are available from November 16 to February 15 of each winter since and including 1924-1925, due to the inauguration of the closed season at that time.

The average catches for each group of years are plotted by months in Figure 34, showing the seasonal fluctuations in abundance. The 1913 to 1916 data are more irregular than the rest, due to the smaller amount of data included, but the trend is unmistakably in agreement with those of the more recent years. The abundance is greatest in each case in the winter season from November to January, when spawning is at its maximum.

TABLE 26.—Number of sets of 6-line skates, total catch in pounds, and average catch per skate in areas 19 to 23 by months and groups of years from 1913 to 1928, giving percentage for each month of total gear fished in each group of years.

Year		Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Total
1913-16	Skates	908	433	.....	1,747	2,438	2,456	697	1,372	1,218	1,892	1,828	1,384	16,373
	Pounds	325,060	99,843	.....	351,939	482,163	338,700	175,674	269,019	184,065	520,011	773,565	677,001	4,197,040
	Average	358	231	.....	201	198	138	252	196	151	275	423	389	256
	Percentage	5.5	2.6	.....	10.7	14.9	15.0	4.3	8.4	7.4	11.6	11.2	8.4	.....
1917-19	Skates	1,250	694	2,088	2,877	3,050	4,519	2,489	2,982	2,070	1,618	2,498	2,994	29,129
	Pounds	294,270	80,017	252,830	421,216	296,830	400,238	238,300	324,225	228,666	223,000	631,003	723,029	4,113,624
	Average	235	115	121	146	97	89	96	109	110	138	253	242	141
	Percentage	4.3	2.4	7.2	9.9	10.5	15.5	8.5	10.2	7.1	5.5	8.6	10.3	.....
1920-22	Skates	650	538	1,157	1,980	2,525	1,921	2,792	2,100	2,169	4,547	4,538	5,012	29,929
	Pounds	127,000	56,013	116,350	222,276	254,960	147,734	325,672	222,250	222,700	560,000	1,059,465	1,232,900	4,547,320
	Average	195	104	101	112	101	77	117	106	103	123	233	246	152
	Percentage	2.2	1.8	3.9	6.6	8.4	6.4	9.3	7.0	7.2	15.2	15.2	16.7	.....
1923-25	Skates	2,431	2,512	3,789	5,385	5,263	4,258	3,901	5,549	5,238	4,692	5,388	1,609	50,015
	Pounds	497,900	266,180	417,600	464,868	402,420	305,004	305,623	421,877	380,743	440,300	971,600	468,800	5,342,915
	Average	205	106	110	86	76	72	78	76	73	94	180	292	107
	Percentage	4.9	5.1	7.6	10.8	10.5	8.5	7.8	11.1	10.5	9.4	10.8	3.2	.....
1926-28	Skates	.....	5,101	7,122	15,504	19,073	11,369	8,688	12,499	10,803	15,172	14,951	.....	120,282
	Pounds	.....	460,775	589,274	1,085,235	1,215,610	730,310	583,664	739,892	626,600	1,080,014	1,547,433	.....	8,658,807
	Average	.....	90	83	70	64	64	67	59	58	71	103	.....	72
	Percentage	.....	4.2	5.9	12.9	15.9	9.5	7.2	10.4	9.0	12.6	12.4	.....	.....

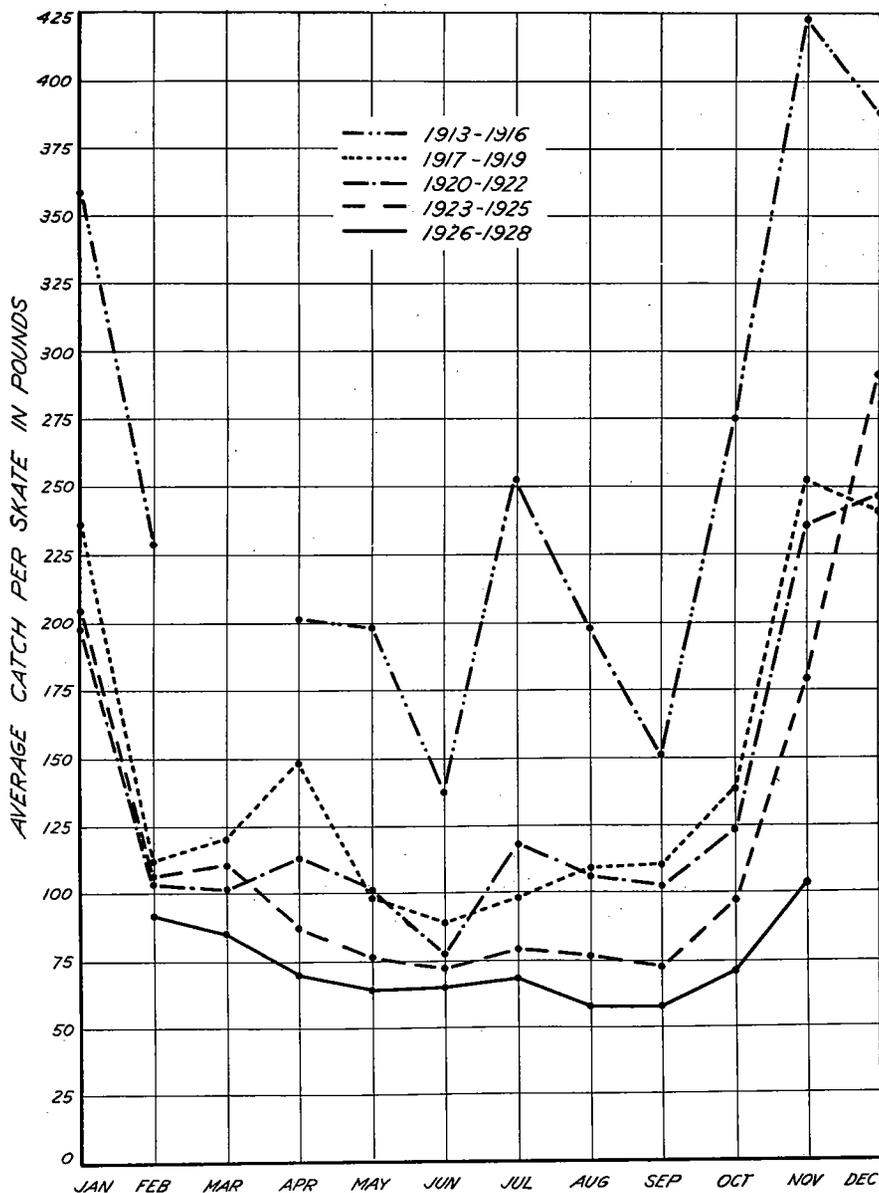


FIGURE 34.—Seasonal change in weight caught per 6-line skate-set in areas 19 to 23 for groups of years from 1913 to 1928.

It declines rapidly in February and slowly throughout the rest of the year to September. It increases in October, and in November rises rapidly to the winter level. The trends of the curves are similar to those obtained for areas 14 to 18, and for the outer coast of areas 11 to 13, but the level of abundance is higher particularly in the winter months, the spawning season, due to the much greater numbers of spawning fish. This high level due to the spawning season persists until the fall of 1924 when the closed season was put into effect and resembles that for the earlier years in the

more southern areas 9 to 18. In view of the much greater catches obtained in the winter season than during the rest of the year, any change in the seasonal intensity of the fishery is necessarily of considerable interest when the interpretation of the annual average catch per unit is considered.

The 1926, 1927, and 1928 data are analyzed separately in Table 27, giving the skates fished, pounds caught, and average catch per skate by months. The averages are plotted in Figure 35. The curves obtained are remarkably similar to one another and to that for the combined data in Figure 17. They show a decline during all seasons of the three years, despite small variations. There can be no doubt of the increase in the catches during winter, which was mentioned earlier, as it is shown unmistakably by each of the curves.

TABLE 27.—*Number of sets of 6-line skates, total catch in pounds, and average catch per skate in areas 19 to 23 for 1926, 1927, and 1928.*

Month	1926			1927			1928		
	Skates	Pounds	Average	Skates	Pounds	Average	Skates	Pounds	Average
Feb.	1,974	170,150	86.2	367	38,500	104.9	2,760	252,125	91.3
Mar.	3,440	239,000	69.5	1,138	126,939	111.5	2,544	223,335	87.8
Apr.	5,057	368,915	73.0	3,124	226,101	72.4	7,323	490,219	66.9
May	4,506	344,660	76.5	5,850	384,750	65.8	8,717	486,200	55.8
June	3,058	225,760	73.8	2,753	191,000	69.4	5,558	313,550	56.4
July	3,062	213,300	69.7	2,246	140,400	62.5	3,380	229,964	68.0
Aug.	4,147	233,450	56.3	3,205	193,650	60.4	5,147	312,792	60.8
Sept.	1,363	89,100	65.4	3,216	194,200	60.4	6,224	343,300	55.2
Oct.	1,833	163,300	89.1	4,461	375,870	84.3	8,878	540,844	60.9
Nov.	2,292	299,800	130.8	5,766	668,200	115.9	6,893	579,433	84.1
Total	30,732	2,347,435	.....	32,126	2,539,610	.....	57,424	3,771,762	.....

The month by month records of number of skates set as shown in Table 26 in terms of percentage of each year's total are too variable for the detailed treatment given in Figures 29 and 31 for the southern areas. For the purpose of determining what changes have occurred in the relative intensity of the fishery in different seasons, our log data in Table 26 have been divided into three four-month periods, March to June, July to October, and November to February, and the relative amounts of fishing determined for each group of years. These periods were selected as being of equal length and the shortest that could include the present closed season in one of them. The results are given in Table 28 as percentages of the total gear fished in each season.

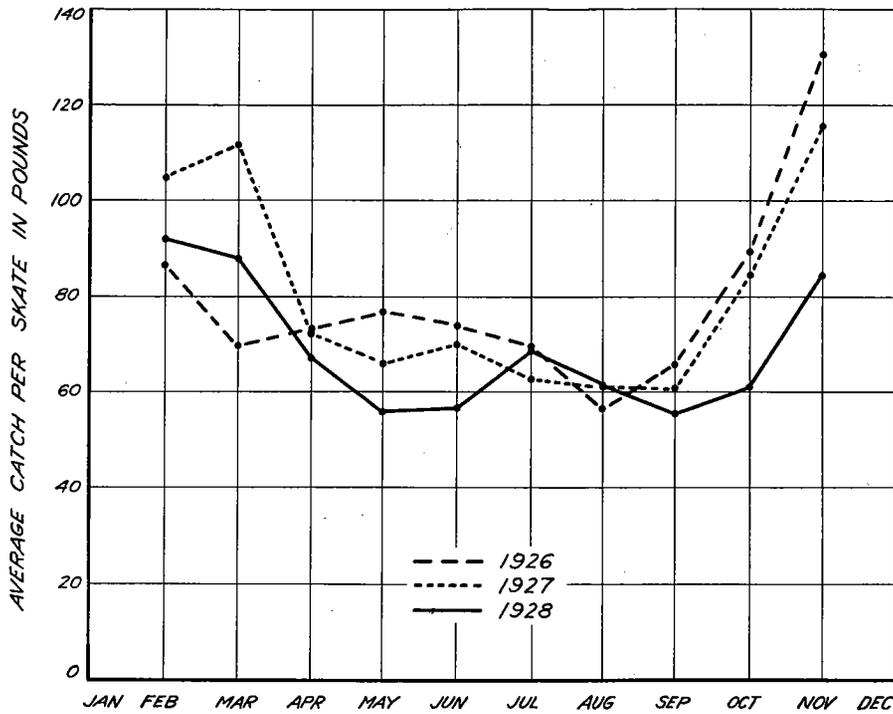


FIGURE 35.—Seasonal change in weight caught per 6-line skate-set in areas 19 to 23 for 1926, 1927, and 1928.

Examination of the preceding table shows that there has been a decided change in the relative intensities of the fishery in the different periods, and particularly in the winter. From 1913 to 1919 the fishery was conducted mainly during the best weather from spring to autumn. During these years only between 25 and 28 per cent of the fishing effort falls in the four months from November to February. In other words, only one-fourth of the fishing was done during that third of the year. From 1920 to 1922 there was a great increase in the proportion of winter fishing, more than one-third being done in that third of the year. The fishery had changed from what may well be termed a summer fishery to an all-year one. The reason for the change was obviously the use of vessels better fitted for the weather, and the greater abundance at that time of year.

TABLE 28.—Percentage for each four-month period of total gear run in each group of years from 1913 to 1928 for areas 19 to 23.

Year	Percentage of Total Fishing		
	Mar. to June	July to Oct.	Nov. to Feb.
1913-1916	40.5	31.5	28.0
1917-1919	43.0	31.5	25.5
1920-1922	25.5	38.5	36.0
1923-1925	37.5	38.5	24.0
1926-1928	44.0	39.0	17.0

The effect of this change on the yearly average catch per unit for that group of years is to make it higher than it would have been with the fishery conducted as before. It is probable that the increased abundance indicated for these years 1920 to 1922 in Figure 34 is in part produced by the inclusion of a greater proportion of fishing in the winter season, when the fish were schooled and the catch per unit of effort was about twice as great as that taken during the rest of the year. The increase in winter fishing is not sufficient to account completely for the increased abundance, however, as will be shown later.

During the years from 1923 to 1925 there is a decided drop in the proportion of fishing done from November to February, and an increase in that done in March to June. There is, in this change, some resemblance to the increased early season fishery in southern areas. But the detailed consideration of the month by month fisheries in the several years does not bear this out (Table 26). And in fact this does not indicate any voluntary change in the habits of the fleet but is due to the inauguration of the closed season from November 16 to February 15, which first took effect in November, 1924, and has been operative each winter since that time. As a result of the closed season, beginning in 1924, only 21 per cent of the total fishing time occurred from November to February during these three years. The fact that 24 per cent of the year's fishing was done in this time indicates that even more fishing than in the previous period was crowded into the remaining winter season. That the average catch had already begun to decline in 1922 and 1923, in spite of the increased winter fishing, is indicated, and it is very probable that this continued in 1924 and 1925. There is no doubt, however, that the sharp decline in 1924 and 1925 (Figure 28) is exaggerated by the elimination of one and one-half months of the best winter fishing in 1924 and three months of the same in 1925.

As the three months closed season has been operative continuously each year since its inauguration, no changes have occurred in the season November to February, which has been 11 per cent of the fishing year. In the last three years, however, 17 per cent of the fishing effort, a considerably higher ratio, have been crowded into these months, indicating increased concentration on the spawning schools in proportion to the available time. This would seem to offer some explanation for the halted decline in the yearly average catch per unit and the slight increase in the apparent abundance in 1926 and 1927. Another factor which must cause fluctuations in abundance, particularly during the winter months, has become operative since the introduction of the closed season—that is the variability of the time of fishing on the spawning schools. Since only the very beginning and end of the spawning season are now open for fishing, small variations in the time of schooling on the spawning grounds or short periods of bad weather affect the catch greatly. Such variations in time of spawning are actually reported by the fishermen. Considering this and the increased intensity during the available winter season, it would seem that no special significance should be attached to the seemingly

increased abundance in these areas during 1926 and 1927, especially in view of the decline in 1928.

But the best possible way of determining whether an actual increase or maintenance of abundance occurred in these areas between 1919 and 1923 is to compare the catches taken in each season, year by year. This will remove the effects of changes in the seasonal intensity of the fishery. In Table 29, the total number of skate-sets, the corresponding catch in pounds, and the calculated catch are tabulated by four-month periods for the several years. The average catches obtained are plotted in Figure 36 as three curves, one for each group of months for the years from 1914 to 1928. Thus divided, the data show some apparently chance variability in alternating years for which it would be futile to advance explanations. This aside, the curves are similar in general trend, yet differ in a manner deserving of some comment.

TABLE 29.—*Number of sets of 6-line skates, total catch in pounds, and average catch per skate by four-month periods from 1913 to 1928 for areas 19 to 23.*

Year	March to June			July to October			November to February		
	Skates	Pounds	Average	Skates	Pounds	Average	Skates	Pounds	Average
1914	171	14,000	82	864	204,000	236	.....	.....	.....
1915	2,327	359,838	155	1,135	355,693	313	1,885	997,666	528
1916	4,143	798,964	193	3,092	580,076	188	2,668	877,803	330
1917	3,303	416,057	126	2,417	310,701	129	2,681	605,513	226
1918	4,845	541,547	112	1,215	141,190	116	2,132	347,769	163
1919	4,386	413,510	94	5,527	562,300	102	2,623	775,047	295
1920	3,235	349,727	107	3,402	328,050	96	2,737	661,378	242
1921	1,723	151,943	88	4,233	596,072	140	3,222	879,000	273
1922	2,625	239,650	91	3,973	406,500	102	4,779	935,000	196
1923	3,689	394,800	107	4,333	504,100	116	5,774	1,361,700	236
1924	6,233	565,665	91	7,644	561,645	73	3,361	533,900	159
1925	8,773	629,427	72	7,403	482,798	65	2,805	308,880	110
1926	16,061	1,178,335	73	10,405	699,150	67	4,266	469,950	110
1927	12,865	928,790	72	13,128	904,120	69	6,133	706,700	121
1928	24,142	1,513,304	63	23,629	1,426,900	60	9,653	831,558	86

The peculiar shape of the series of annual averages shown in Figure 17 is recognizable in each curve. It is evident in each of these that, following the low level of about 1918 or 1919, the abundance—or catch per unit—either maintained itself or declined at a lower rate until 1923. This might fairly be taken to show that under reduced fishing, the banks could maintain themselves at the relatively high level of one hundred pounds or over. However, there are most unfortunately no accurate data as to the total

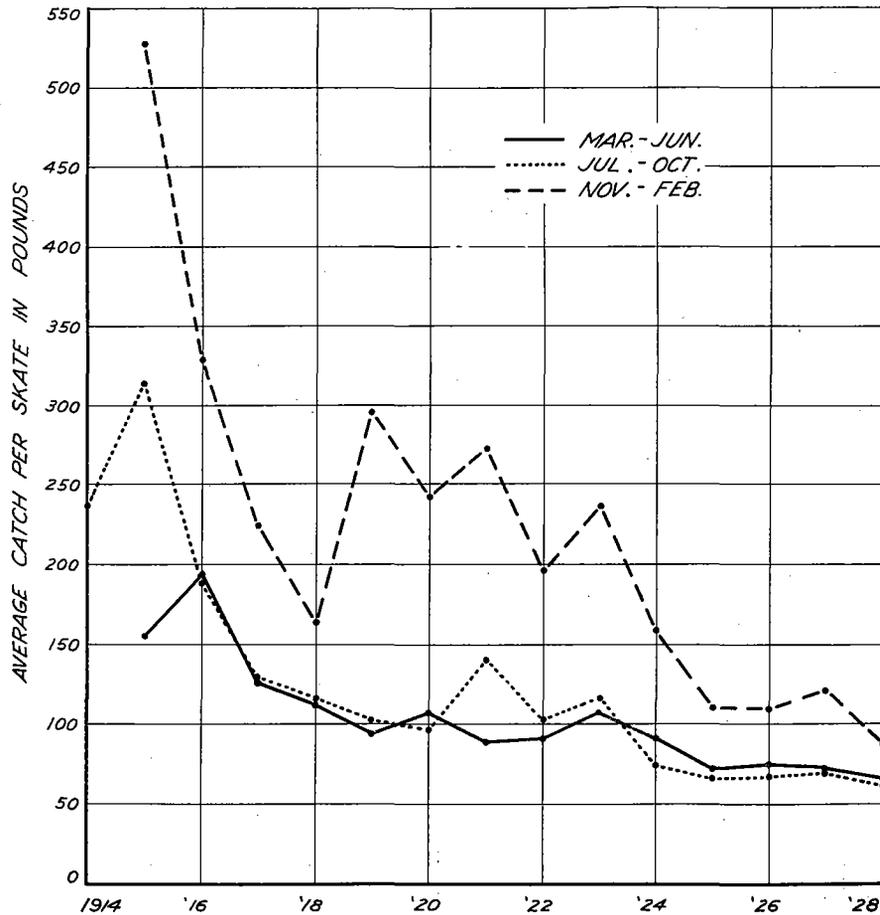


FIGURE 36.—Comparison of decline during various seasons in average weight caught per 6-line skate-set in areas 19 to 23 from 1914 to 1928.

amounts taken during these years from the several banks, and the conclusion rests upon indirect historical evidence.

The catch during the November to February season falls at the same rate as those for the other seasons between 1916 and 1918, and from 1924 to 1927—during those years being between one and one-half and two times as great as in the other seasons. But in 1919 the catch during the winter months was about three times as great as during the balance of the year, and this ratio fell off gradually until in 1924 it was again less than twice, and in 1928 but about one and one-half times as great. The depression in the winter season of 1918 was therefore distinguished from those of the two remaining seasons by a recovery to a much higher level. This, in the light of our tagging experiments, must have been a relatively rapid influx of matures from untouched stock to the west, affecting mainly the spawning season.

The halibut fishery on this part of the coast was, and still is, directed primarily at fish over $11\frac{3}{4}$ pounds in weight, cleaned but not headed,

this being the lower size limit of first-class fish. This is approximately the average size at which fish on the western grounds mature.

The catch, especially in areas 19 to 23, is made up during the winter almost entirely of these mature fish, small males and larger females (Thompson and Herrington, 1930, Table 1, Figure 9), which migrate widely. But during the spring and summer months the catch on any given bank includes in addition to those matures which come from spawning, immature fish which are largely resident, if we may judge from tagging results on southern banks. There are, then, really to be considered two stocks, one migratory, based upon fish which mature from the stocks on all the western banks, the other in part at least based upon non-migratory fish in process of maturing from eggs and larvae which have come to rest in the areas considered. The reserve power of immediate replacement by immigration is obviously far greater for the stock of mature migrants, as the local stock would not be expected to show additions for a period equal to that required for growth from egg to commercial size, about ten to thirteen years here.

This explanation for the peculiar course of the abundance, one which rests upon considerable evidence, depends upon the recent work on the history of the banks and the marking experiments (Thompson and Freeman, 1930; and Thompson and Herrington, 1930). The first intensive exploitation of these banks took place between 1913 and 1918. Evidently mature and immature stocks alike were quickly reduced. But with the slackening of the fishery, particularly in the more distant areas, the migratory mature stock, drawing from distant untouched banks, quickly replaced part of the loss and maintained itself at a higher level than the stock of the summer months, to which the non-migratory population is of predominant importance. With the renewal of the intensive fishery by Diesel-motored craft in 1923, and its spread westward, mature and immature alike everywhere seem to have suffered equally. Perhaps there are, indeed, better explanations, but this, which rests upon the fact that a greater stock of the mature migrants than of immatures was being tapped, seems the most apparent at present.

The effect of the closed season may, as has been said, be perhaps evident in the fall of catch per unit in 1924 and 1925, during November to February, as the result of elimination of the most productive part of the fishery for schooling spawners. But this is to a considerable extent negated by the fact that there was a nearly proportionately equal fall during the remainder of the year. In 1926 and 1927 there seems to have been an increase in catch per unit again, perhaps due to the reduction of the strain on the stocks concerned, but perhaps due to a temporary fluctuation, counteracted by a sharp fall in 1928. At all events, the effect of the closed season is not prominent, if visible at all, despite the great mass of data in the last few years. The ratio of average catches per unit-set made during the small part of the spawning season still open to fishing, to the catches per unit-set made during the remainder of the year should reflect

the relative abundance of the protected spawners, since it does this in previous years in all areas. Yet the ratio in 1928 of catch per unit during the winter season to that during the summer was the smallest in the history of the banks (Table 30), and certainly no real increase in the ratio has occurred since the first full year of closure, 1925, in which a fall reflects the elimination of the most favorable winter fishery of previous years.

TABLE 30.—*Ratio of average catch per set of a 6-line skate in November to February to the average in the remainder of the year in areas 19 to 23 for years from 1915 to 1928.*

Year	Ratio	Year	Ratio
1915	2.55	1922	2.00
1916	1.73	1923	2.11
1917	1.78	1924	1.96
1918	1.44	1925	1.59
1919	3.01	1926	1.55
1920	2.37	1927	1.70
1921	2.17	1928	1.39

The net result of our examination of the catch per unit-set in areas 19 to 23, over the period of years from 1914 to 1928, is that the fall in abundance of the stocks is a distinct one, that it has not been decisively altered by the closed season. The exact consideration of the rate of decline is complicated by the migratory habits of the matures, by the presence at one time of undepleted stocks to the west, and by the effects of the closed season. The possibility of natural variability in the abundance or catch is sufficiently great in all our records, to discourage too refined analysis of the averages for even the last three years. Not merely are we unable, but we regard it as assuming too much, to read into our data for any part of our record an even rate of fall in abundance, such as was indicated for areas 9 to 13 over the long period of years from 1906 to 1928. However, that there has been a very great fall in abundance, both of presumably resident stock characteristic of summer catches, and of the migratory winter stock, is beyond dispute.

SEASONAL CHANGES IN AREAS 24 TO 28

The log data of fishing in areas 24 to 28 are summarized in Table 31 by months for different groups of years—1914 to 1916, 1917 to 1919, 1920 to 1922, 1923 to 1925, and 1926 to 1928. The monthly averages are plotted for each group of years in Figure 37, omitting the averages for February and November of 1914 to 1916, November of 1917 to 1919, and January of 1920 to 1922, because the data in each of these are so few as to render them unreliable. The data for the earliest years are not very numerous, but when grouped are sufficient to give an approximate idea of the seasonal fluctuations in abundance and the seasonal distribution of the fishery.

TABLE 31.—Number of sets of 6-line skates, total catch in pounds, and average catch per skate in areas 24 to 28 by months and groups of years from 1914 to 1928, giving percentage for each month of total gear run in each group of years.

Year		Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Total
1914-16	Skates	456	165	1,166	2,149	828	1,638	1,839	2,475	2,035	1,349	190	.....	14,288
	Pounds	86,587	13,410	176,252	461,995	180,668	278,986	303,826	403,409	553,637	404,161	130,135	.....	2,993,066
	Average	183	81	151	215	219	170	165	163	272	300	685	.....	210
	Percentage	3.2	1.2	8.2	15.0	5.8	11.5	12.9	17.3	14.2	9.4	1.3	.....	.....
1917-19	Skates	.....	.....	886	3,212	7,178	4,966	1,486	1,263	663	580	211	.....	20,445
	Pounds	.....	.....	107,991	629,083	828,259	646,475	139,879	135,362	33,328	86,000	57,000	.....	2,663,377
	Average	.....	.....	122	196	115	130	94	107	50	148	270	.....	130
	Percentage	.....	.....	4.3	15.7	35.1	24.3	7.3	6.2	3.2	2.8	1.0	.....	.....
1920-22	Skates	154	648	4,408	4,813	7,150	7,741	5,502	1,238	3,055	491	403	.....	35,603
	Pounds	26,000	101,000	705,004	738,468	929,023	954,891	569,642	155,056	383,611	77,000	64,000	.....	4,703,695
	Average	169	156	160	153	130	123	104	125	126	157	159	.....	132
	Percentage	.4	1.8	12.4	13.5	20.1	21.7	15.5	3.5	8.6	1.4	1.1	.....	.....
1923-25	Skates	.....	3,011	7,807	10,252	14,210	10,969	10,659	16,225	9,274	8,432	4,111	.....	94,950
	Pounds	.....	584,000	1,307,328	1,227,595	1,257,632	1,042,350	1,118,001	1,828,640	912,617	954,200	531,554	.....	10,763,917
	Average	.....	194	167	120	89	95	105	113	98	113	129	.....	113
	Percentage	.....	3.2	8.2	10.8	15.0	11.5	11.2	17.1	9.8	8.9	4.3	.....	.....
1926-28	Skates	.....	17,489	28,677	26,593	27,225	25,511	27,302	42,645	39,714	27,980	5,924	.....	269,060
	Pounds	.....	2,515,533	2,928,244	2,168,092	2,080,654	2,098,047	2,286,642	3,337,425	2,907,080	2,016,647	542,684	.....	22,881,048
	Average	.....	144	102	82	76	82	85	78	73	72	92	.....	85
	Percentage	.....	6.5	10.7	9.9	10.1	9.5	10.1	15.8	14.7	10.4	2.2	.....	.....

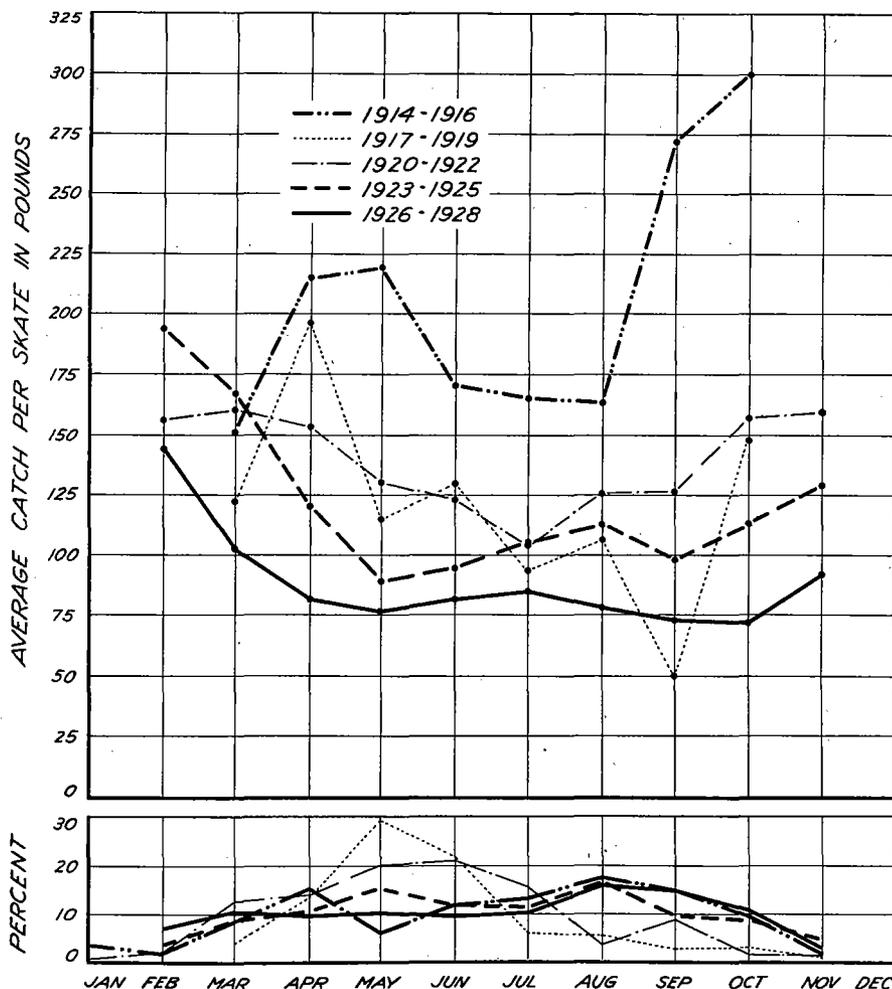


FIGURE 37.—Seasonal change in average catch per unit and in amount of gear run in areas 24 to 28 by groups of years from 1914 to 1928. Upper—Average weight caught per 6-line skate-set. Lower—Percentage for each month of total gear fished in each group of years.

Except for the earliest years of the fishery (1914 to 1916) the seasonal fluctuations in abundance are similar to those found in areas 14 to 18 and 19 to 23, and to those of the outer coast of areas 11 to 13. The catches are high in spring but drop off rapidly. In general they decline slightly throughout the summer in the early years, but from 1923 to 1928 a possible slight increase in summer with a decrease in fall is indicated. They rise rapidly in the late fall upon the approach of the spawning season. The great catches obtained in areas 19 to 23 during the spawning season are not shown here, but this is probably due to the fact that the boats are not fishing at the right time, since spawning schools are met with on nearer banks in areas 19 to 23. Relatively little fishing is shown from November to February in any of the years. No definite reason for the poor catches in March of 1914 to 1916, which are totally unlike what were

found at all other times, can be given. However, they are probably due to unfamiliarity with the grounds, as these were the years during which the voyages were more or less exploratory in nature. The trend of the catches for these years from May to October is in agreement with the trends of all other years, but at a much higher level.

The general levels of abundance show the decline from 1914 to 1928, but the two periods from 1917 to 1919 and from 1920 to 1922 show less difference than the others.

In these areas there is again to be seen the emergence in late years, 1923 to 1928, of the same summer rise in abundance as has been remarked upon in other areas. It is corroborated by the separate analysis of the years 1926, 1927, and 1928, given in Table 32 and Figure 38.

TABLE 32.—*Number of sets of 6-line skates, total catch in pounds, and average catch per skate in areas 24 to 28 for 1926, 1927, and 1928.*

Month	1926			1927			1928		
	Skates	Pounds	Average	Skates	Pounds	Average	Skates	Pounds	Average
Feb.	8,708	1,361,145	156.3	2,287	326,200	142.6	6,494	828,188	127.5
Mar.	11,787	1,270,577	107.8	7,466	846,591	113.4	9,424	811,076	86.1
Apr.	13,705	1,278,500	93.3	5,600	420,528	75.1	7,288	469,064	64.4
May	10,927	865,975	79.3	6,689	505,620	75.6	9,609	709,059	73.8
June	7,155	701,000	98.0	6,125	542,600	88.6	12,231	854,447	69.9
July	6,314	605,000	95.8	7,993	725,355	90.7	12,995	956,287	73.6
Aug.	15,325	1,373,680	89.6	9,520	771,570	81.0	17,800	1,192,175	67.0
Sept.	13,586	1,141,400	84.0	9,727	727,835	74.8	16,401	1,037,845	63.3
Oct.	7,725	629,650	81.5	6,524	385,885	59.1	13,731	1,001,112	72.9
Nov.	1,428	137,100	96.0	2,064	211,784	102.6	2,432	193,800	79.7
Total	96,660	9,364,027	.....	63,995	5,463,968	.....	108,405	8,053,053	.....

The similarity of the seasonal fluctuations found here to those found in areas 9 to 13 is very pronounced and deserves some attention. The grounds themselves are no more like those in areas 9 to 13 than to those in 19 to 23, so the nature of the grounds cannot be the cause. There is, however, one very definite point of similarity—that is the type of population. Portlock, which is the most extensively fished bank in areas 24 to 28, is characterized by a great proportion of immature fish. The increase in abundance shown in summer is therefore most probably produced by seasonal changes in the feeding habits of these fish. The greater relative catches in summer during the late years may well be assigned to the greater depletion of the mature fish and the corresponding increase in importance of the immatures. All changes obviously must effect the interpretation of Figure 38, where the yearly averages are compared.

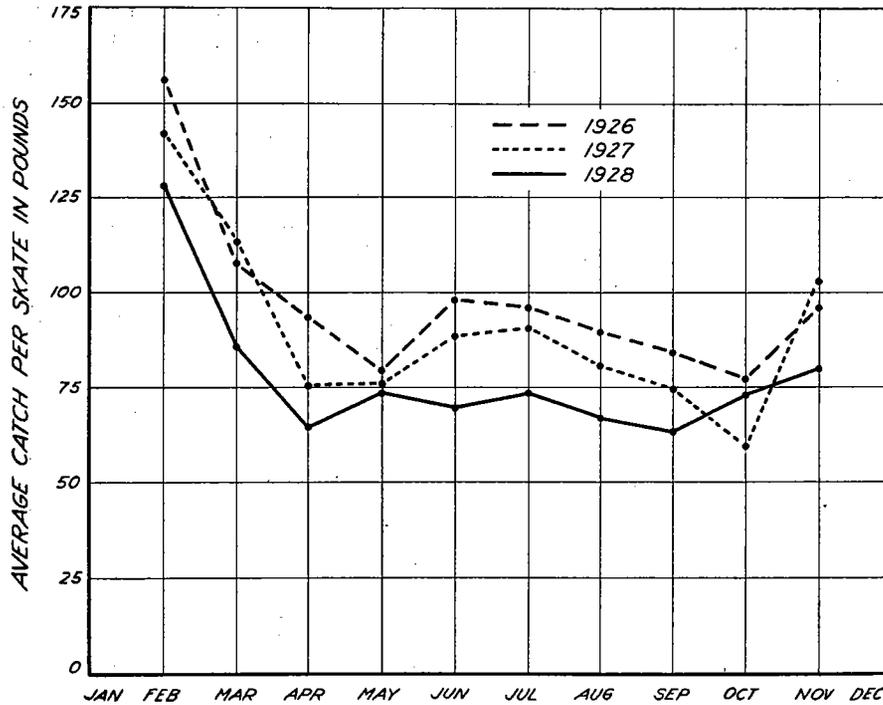


FIGURE 38.—Seasonal change in average weight caught per 6-line skate-set in areas 24 to 28 for 1926, 1927, and 1928.

The seasonal distribution of the intensity of the fishery can be studied in Table 31 and Figure 37. It is shown there that the early steamer fishery from 1914 to 1916 resembled in seasonal distribution that of the Diesel-motored vessels from 1923 to 1928. But during the years 1917 to 1922, when the steamers were declining in number and the catches on distant banks were less, the fishery was almost entirely a spring one.

To give a tabular picture of these changes in the seasonal distribution since the fishery began about 1914, the percentage fishing in the same four-month periods of the year as were used for areas 19 to 23, are given for each group of years in Table 33.

TABLE 33.—Percentage for each four-month period of total gear run in each group of years from 1914 to 1928, for areas 24 to 28.

Year	Percentage of Total Fishing		
	Mar. to June	July to Oct.	Nov. to Feb.
1914-1916	40.5	54.0	5.5
1917-1919	79.5	19.5	1.0
1920-1922	67.5	29.0	3.5
1923-1925	45.5	47.0	7.5
1926-1928	40.5	51.0	8.5

The fact at once becomes clear that the winter fishery, as compared to the summer one in these areas, has never been of any considerable importance. That it has increased in the later years is, however, apparent. The decrease in amount of fishing from the period 1914 to 1916 to the period 1917 to 1919 is due to a change in the fleet. Only steamers of large size fished so far to the westward in the stormy winter months from 1914 to 1916, and the gradual withdrawal of these from the fishery in the succeeding group of years causes the decrease from 5½ per cent to 1 per cent for that third of the year. The schooner fleet that remains, of which we have records, gradually extended its operations into the winter months. From 1920 to 1922 they did about 3½ per cent of their fishing in that third of the year; from 1923 to 1925, about 7½ per cent in the 21 per cent of the fishing time; and from 1926 to 1928, about 8½ per cent in the 11 per cent of the fishing time left by the closed season during the four months from November to February. In each of these groups of years the percentage of fishing done in the winter time is always less than that done during the same season in areas 19 to 23. This difference is largely due to the inclement weather encountered at that time of year and the advantages in fishing on spawning grounds nearer the ports where the fleet lands its catches.

The shift to a spring fishery in the period 1917 to 1922 was to a season of higher average catches, and the annual average catch should therefore be higher. But in Table 12 and Figure 19 this period from 1917 to 1922 is shown to be one of low annual catch per unit, increasing to 1923, as also in areas 19 to 23. It is obvious from this that the catches might well have been still lower had the change in the fishery not occurred, and that it is fair to presume that the actual abundance was proportionately lower than our evidence shows for these years in Table 12.

TABLE 34.—Number of sets of 6-line skates, total catch in pounds, and average catch per skate in areas 24 to 28 by four-month periods from 1914 to 1928.

Year	March to June			July to October			November to February		
	Skates	Pounds	Average	Skates	Pounds	Average	Skates	Pounds	Average
1914	181	40,000	221	.....	.....	.....	.....	.....	.....
1915	3,539	776,402	220	6,238	1,455,307	233	190	130,135	684
1916	2,059	281,499	136	1,460	209,726	143	621	99,997	161
1917	3,676	614,764	167	1,993	250,277	125	211	57,000	270
1918	4,718	616,745	131	888	82,567	94	.....	.....	.....
1919	7,848	980,299	125	1,111	61,725	56	.....	.....	.....
1920	8,018	1,300,261	162	2,332	272,294	117	56	19,000	339
1921	8,451	1,000,925	131	2,887	286,015	100	518	72,000	139
1922	7,643	1,026,200	134	5,067	627,000	124	579	100,000	173
1923	6,846	929,800	136	8,422	1,129,039	134	586	127,254	217
1924	15,032	1,740,288	116	17,265	1,943,255	113	2,501	332,300	133
1925	21,360	2,164,817	101	18,903	1,741,164	92	4,035	656,000	163
1926	43,573	4,116,052	94	42,950	3,749,580	87	10,137	1,498,245	148
1927	25,880	2,315,339	89	33,764	2,610,645	77	4,351	537,984	123
1928	38,553	2,843,646	74	60,927	4,187,419	69	8,925	1,021,988	114

To eliminate the effect of seasonal changes in intensity, the data for each year from 1914 to 1928 have been arranged in Table 34 by four-month periods and the average catch per skate for each period of each year calculated. The average catches obtained are plotted for each period of the year in Figure 39. The average catches for March to June of 1914 and for November to February of 1915, 1917, and 1920 have been omitted as the data are too few to give reliable averages.

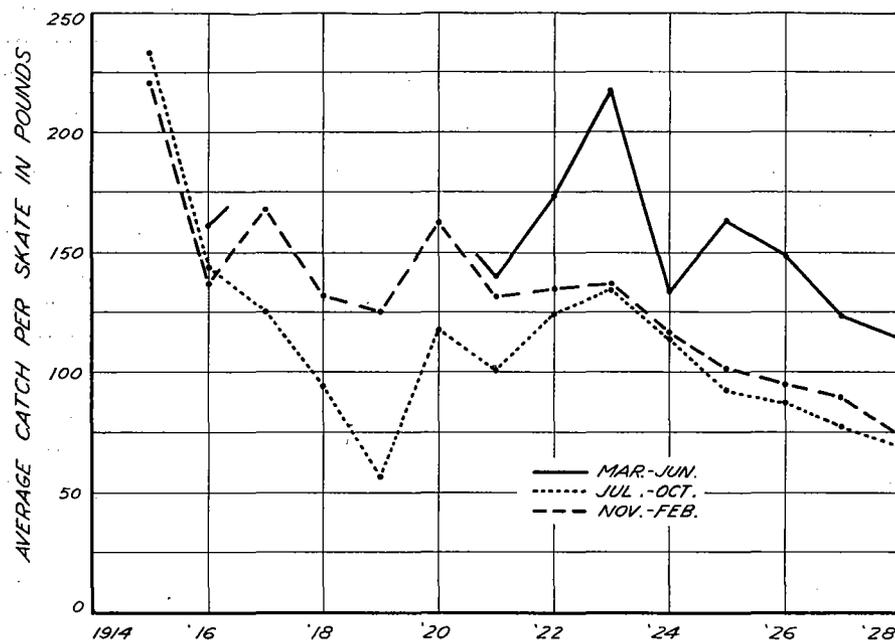


FIGURE 39.—Seasonal change in average weight caught per 6-line skate-set in areas 24 to 28 from 1915 to 1928.

The similarity of the curves obtained to those for the corresponding seasons in areas 19 to 23 (Figure 36) is quite remarkable. The March to June data show at least a cessation of decline following 1919 and probably a slight increase in abundance, just as in areas 19 to 23. The data for July to October on the other hand show a very decided increase as in the other region. Unfortunately the curve for the months from November to February lacks sufficient data for the critical years. Nevertheless, it will be observed that the relationship shown by the parts that are present to the corresponding sections of the other two curves are similar to the relationships found in areas 19 to 23, Figure 36. There is every reason to believe that the increase in abundance also occurred in the winter season here as in the other region. In any event, the fact of increased abundance during these years in areas 24 to 28 cannot reasonably be disputed. In view of the results of tagging experiments (Thompson and Herrington, 1930) which have shown that the mature fish in the region west of Cape Spencer intermingle freely, it was to be expected that an increase in abundance during the same years would be found in areas 24 to 28, especially

as the increased abundance found in areas 19 to 23 was shown to apply particularly to mature fish.

It is interesting to note that in this region the closed season has not produced any change in the rate of decline for the winter periods as it did in areas 19 to 23. The decline from 1923, the last year before the closed season became operative to 1928, was 46 per cent for March to June, 49 per cent for July to October, and 47 per cent for November to February. This should indicate that the closed season has had little if any effect on the winter fishery in this region, which is in agreement with the conclusion reached from the study of seasonal intensity. If any important part of the spawning season, used prior to the closed season, had been removed from the fishery by the closure, the catch should have been reduced more during this season than during the remainder of the year which the closure does not affect.

SEASONAL CHANGES IN AREAS 29 TO 36

The log records of fishing done in areas 29 to 36, that part of the coast lying between the west end of Kodiak Island and Unalaska and including the grounds around Trinity, Chirikof, Semidi, and Shumagin Islands, are sum-

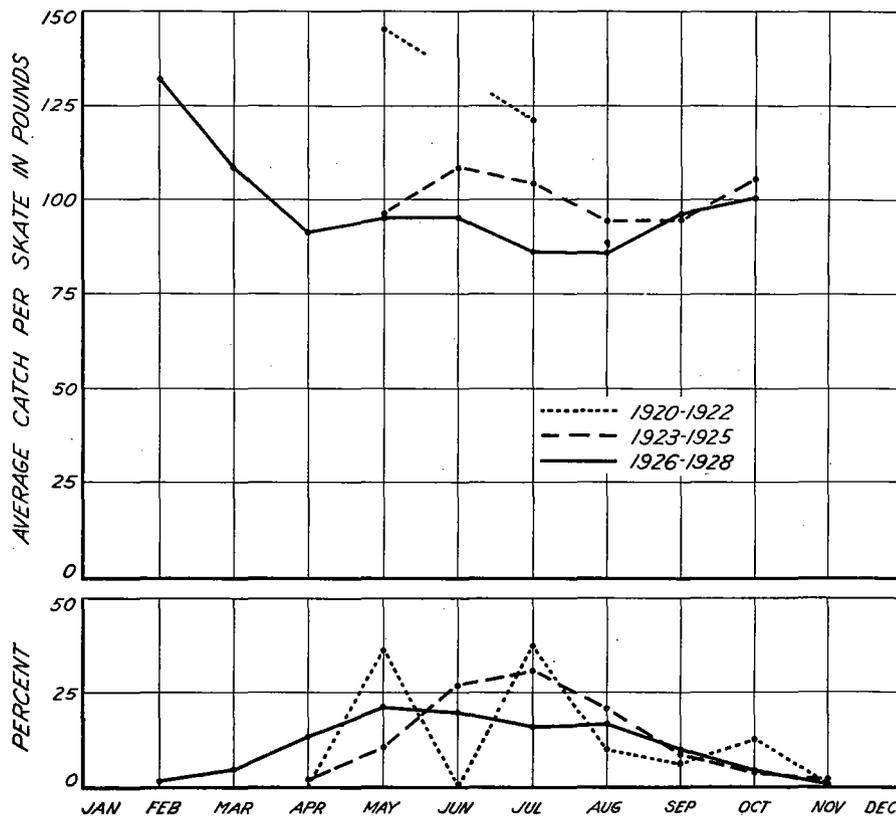


FIGURE 40.—Seasonal change in average catch per unit and in amount of gear run in areas 29 to 36 by groups of years from 1920 to 1928. Upper—Average weight caught per 6-line skate-set in areas 29 to 36. Lower—Percentage for each month of total gear fished in each group of years.

TABLE 35.—Number of sets of 6-line skates, total catch in pounds, and average catch per skate in areas 29 to 36 by months and groups of years from 1920 to 1928, giving percentage for each month of total gear fished in each group of years.

Year		Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Total
1920-22	Skates	.....	.....	.....	.....	679	.....	704	176	118	232	.....	.....	1,909
	Pounds	.....	.....	.....	.....	98,694	.....	85,020	20,000	7,000	43,602	.....	.....	254,316
	Average	.....	.....	.....	.....	145	.....	121	114	59	188	.....	.....	133
	Percentage	.....	.....	.....	.....	35.6	.....	36.9	9.2	6.2	12.1	.....	.....	.....
1923-25	Skates	.....	.....	.....	235	1,668	5,003	5,577	3,903	1,442	502	250	.....	18,580
	Pounds	.....	.....	.....	20,000	158,000	584,250	604,600	364,400	136,200	55,000	27,000	.....	1,949,450
	Average	.....	.....	.....	85	95	117	108	93	94	110	108	.....	105
	Percentage	.....	.....	.....	1.3	9.0	26.9	30.0	21.0	7.8	2.7	1.3	.....	.....
1926-28	Skates	.....	1,260	4,073	13,215	21,045	18,434	15,499	16,665	9,046	3,025	208	.....	102,470
	Pounds	.....	165,873	461,674	1,202,984	1,984,636	1,739,794	1,332,978	1,424,354	859,979	303,195	30,000	.....	9,505,467
	Average	.....	132	113	91	94	94	86	85	95	100	144	.....	93
	Percentage	.....	1.2	4.0	12.9	20.5	18.0	15.1	16.3	8.8	3.0	.2	.....	.....

marized in Table 35. The number of skates of the standard 6-line gear-set, the catch in pounds, the average catch per skate as calculated therefrom and the percentage of total fishing for the respective years are given by months for different groups of years, 1920 to 1922, 1923 to 1925, and 1926 to 1928. In Figure 40, upper, are plotted the average monthly catches, except those for August, September, and October of 1920 to 1922, April and November of 1923 to 1925, and November of 1926 to 1928, all of which were considered unreliable because of the scantiness of the data from which they were derived. In Figure 40, lower, the percentages of the total fishing done each month of the three periods, 1920 to 1922, 1923 to 1925, and 1926 to 1928 are given.

The decline in catch shown for the summer season in Figure 40, upper, is in general agreement with the decline shown for the average yearly catches in Figure 20. The fall between the period 1920 to 1922 and that of 1926 to 1928 for this season has been from about 130 pounds per skate to 90 pounds per skate, a decline of 31 per cent.

The seasonal fluctuations in catch, as indicated by the period 1923 to 1925 and the period 1926 to 1928, are similar to those in areas 19 to 23 and 24 to 28. According to the 1926 to 1928 data, the catch per skate is at its maximum in the winter months when the fishing effort is least and at a minimum from April to August, when the fishing is most intense. The catches are at a slightly higher level here than in the regions to the east of it, in keeping with its less accessible position.

TABLE 36.—Number of sets of 6-line skates, total catch in pounds, and average catch per skate in areas 29 to 36 for 1926, 1927, and 1928, giving percentage for each month of total gear run in each year.

Month	1926				1927				1928			
	Skates	Pounds	Average	Percentage	Skates	Pounds	Average	Percentage	Skates	Pounds	Average	Percentage
Feb.	.....	.....	.....	.....	270	45,000	166.7	.9	990	120,873	122.1	2.7
Mar.	1,277	131,300	102.8	3.7	1,005	137,500	136.8	3.2	1,791	192,874	107.7	4.9
April	3,092	329,900	106.7	9.1	3,045	266,400	87.5	9.6	7,078	606,684	85.7	19.3
May	7,072	798,835	113.0	20.7	7,022	714,200	101.7	22.2	6,951	471,601	67.8	18.9
June	8,514	844,984	99.2	24.9	4,648	450,660	97.0	14.7	5,272	444,150	84.2	14.3
July	5,465	525,335	96.1	16.0	4,165	393,443	94.5	13.2	5,869	414,200	70.6	16.0
Aug.	5,560	533,600	96.0	16.3	5,640	492,630	87.3	17.8	5,465	398,124	72.8	14.9
Sept.	2,837	298,600	105.3	8.3	4,121	388,269	94.2	13.0	2,088	173,110	82.9	5.7
Oct.	327	30,000	91.7	1.0	1,476	180,200	122.1	4.7	1,222	92,995	76.1	3.3
Nov.	.....	.....	.....	.....	208	30,000	144.2	.7	.....	.....	.....	.....
Total	34,144	3,492,554	.....	100.0	31,600	3,098,302	.....	100.0	36,726	2,914,611	.....	100.0

In Table 36 the 1926, 1927, and 1928 data are analyzed separately to get the average monthly catch for each of these years and also the seasonal variation in intensity. The average catches for each of these years are plotted by months in Figure 41, upper. While the curves are not in exact agreement, the catches in February and March of 1927 and 1928 and of October and November of 1927 indicate that there is a distinct winter schooling, due probably to the presence of spawners in considerable numbers. The failure of the 1926 curve to indicate the same phenomenon in March and October cannot be ascribed to the absence of spawning schools in that year, but since the fishery was utilizing these months for the first time in these areas, rather to lack of knowledge of the grounds.

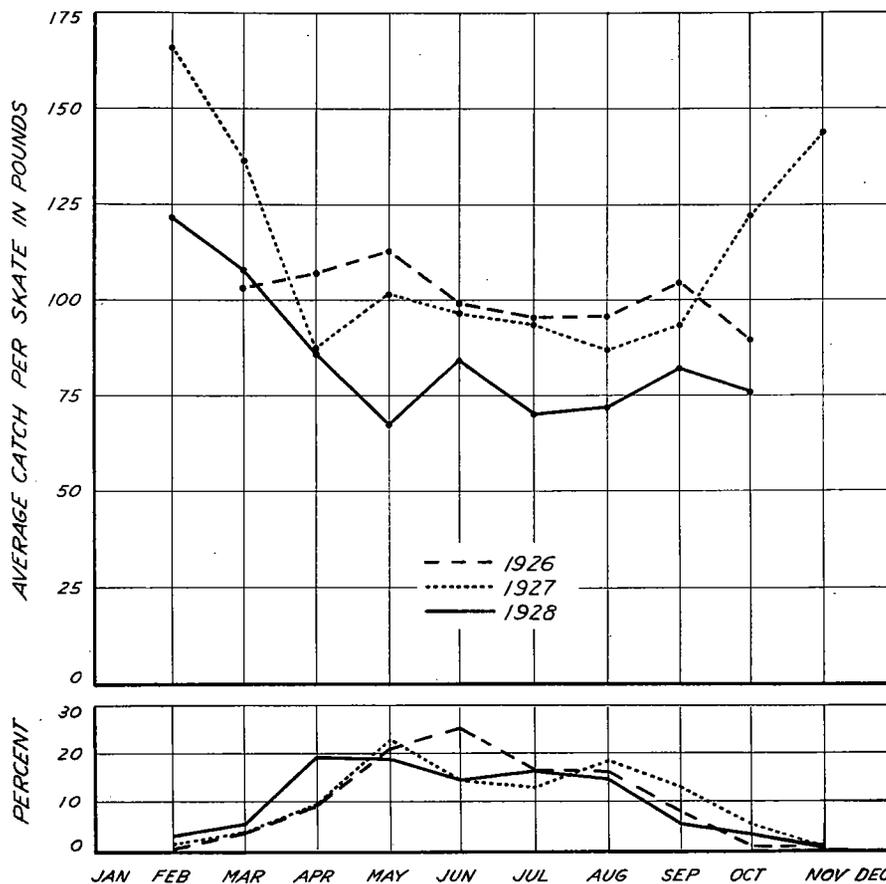


FIGURE 41.—Seasonal change in average catch per unit and in amount of gear run in areas 29 to 36, during 1926, 1927, and 1928. Upper—Average weight caught per 6-line skate-set. Lower—Percentage for each month of total gear fished in each year.

Figure 40, lower, clearly indicates that the fishery in this region has been and is essentially a summer fishery which was to be expected in view of the great distance from the main ports of landing. The data show that the summer season only was utilized from 1920 to 1922, the earliest years in which commercial halibut fishing was conducted this far west along the

Alaskan coast. From 1923 to 1925, the first fishing began in March and the last was done in November. Over 75 per cent of the fishing, however, was done in June, July, and August. In the period 1926 to 1928, the season is longer, some fishing being done as early as February. The nature of the fishery remains the same, as 70 per cent of the fishing occurs from May to August. The expansion into the earlier months is a direct result of the decreased abundance in the more accessible regions and the need to go further afield for profitable catches.

In view of the seasonal distribution of the fishery, it is clearly indicated that the present closed season has no effect on the fishery through direct restriction of fishing in this region itself. From 1923 to 1925, only 1.3 per cent an unimportant amount of the fishing, was done during the months in which the closed season is operative. This does not mean that the stock on these banks has not been affected, however. Tagging experiments (Thompson and Herrington, 1930) mentioned earlier, indicated that at least part of the mature stock on these grounds during the summer season is present on the spawning grounds off Yakutat Bay and on the W Ground during the spawning season. Whether this is the result of an actual spawning migration or simple intermixture of the stocks on the different grounds has not been definitely determined.

Figure 41, lower, where the percentages of gear fished by month for each of the three years are plotted, shows that a change has taken place even in that short period. There is a decided tendency toward utilization of more of the year than formerly, particularly of the early part of it. The maximum intensity of the fishery in 1926 was in May and June, in 1927 it was in May, and in 1928 it was in April and May.



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APPENDIX A.

Number of sets of 6-line skates and total catch in pounds by groups of areas for each month from 1913 to 1928.

Year	Area		January	February	March	April	May	June	July	August	September	October	November	December	Total
1913	1-8	Sk.	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
		Wt.	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
	9-13	Sk.	-----	-----	420	569	1,476	1,792	1,056	686	835	1,149	504	489	8,976
		Wt.	-----	-----	28,000	67,000	195,300	398,000	157,000	56,000	106,000	81,400	30,700	38,000	1,157,400
	14-18	Sk.	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
		Wt.	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
1913	19-23	Sk.	-----	-----	-----	-----	-----	-----	88	-----	-----	-----	-----	-----	88
		Wt.	-----	-----	-----	-----	-----	-----	9,000	-----	-----	-----	-----	-----	9,000
1913	Total	Sk.	-----	-----	420	569	1,476	1,792	1,056	774	835	1,149	504	489	9,064
		Wt.	-----	-----	28,000	67,000	195,300	398,000	157,000	65,000	106,000	81,400	30,700	38,000	1,166,400
1914	1-8	Sk.	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
		Wt.	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
	9-13	Sk.	607	528	1,316	1,151	1,224	1,593	1,524	1,260	1,525	499	660	-----	11,887
		Wt.	36,215	42,000	120,000	153,500	336,000	186,500	170,500	241,000	134,000	14,000	26,400	-----	1,460,115
	14-18	Sk.	-----	-----	-----	-----	-----	123	43	-----	-----	-----	-----	-----	166
		Wt.	-----	-----	-----	-----	-----	32,000	4,000	-----	-----	-----	-----	-----	36,000
1914	19-23	Sk.	-----	-----	-----	-----	-----	171	416	448	-----	-----	-----	-----	1,035
		Wt.	-----	-----	-----	-----	-----	14,000	96,000	108,000	-----	-----	-----	-----	218,000
1914	24-28	Sk.	-----	-----	-----	-----	-----	181	-----	-----	-----	-----	-----	-----	181
		Wt.	-----	-----	-----	-----	-----	40,000	-----	-----	-----	-----	-----	-----	40,000
1914	Total	Sk.	607	528	1,316	1,151	1,224	1,983	1,708	1,525	499	660	-----	-----	13,269
		Wt.	36,215	42,000	120,000	153,500	336,000	272,500	270,500	349,000	134,000	14,000	26,400	-----	1,754,115
1915	1-8	Sk.	-----	-----	-----	-----	473	52	-----	-----	-----	60	-----	-----	585
		Wt.	-----	-----	-----	-----	175,300	2,700	-----	-----	-----	2,200	-----	-----	180,200
	9-13	Sk.	12	544	1,013	840	2,293	1,816	4,723	3,669	1,819	1,116	40	-----	17,885
		Wt.	200	59,900	53,100	63,400	300,600	190,400	515,600	523,900	179,500	96,400	500	-----	1,983,500
	14-18	Sk.	-----	227	368	303	-----	-----	-----	-----	-----	-----	133	-----	1,031
		Wt.	-----	43,000	53,100	36,800	-----	-----	-----	-----	-----	-----	5,000	-----	137,900
1915	19-23	Sk.	-----	-----	-----	803	474	1,050	281	563	-----	291	988	897	5,347
		Wt.	-----	-----	-----	132,722	84,211	142,905	79,674	86,019	-----	190,000	540,667	456,999	1,713,197
1915	24-28	Sk.	-----	-----	-----	1,704	826	1,009	1,074	1,780	2,035	1,349	190	-----	9,967
		Wt.	-----	-----	-----	407,793	180,668	187,941	180,650	316,859	553,637	404,161	130,135	-----	2,361,844
1915	Total	Sk.	12	771	1,381	3,650	4,066	3,927	6,078	6,012	3,854	2,816	1,351	897	34,815
		Wt.	200	102,900	106,200	640,715	740,779	523,946	775,924	926,778	733,137	692,761	676,302	456,999	6,376,641

APPENDIX A—(Continued).

Year	Area		January	February	March	April	May	June	July	August	September	October	November	December	Total	
1916	1-8	Sk.	-----	-----	-----	362	58	572	-----	-----	-----	24	-----	-----	1,016	
		Wt.	-----	-----	-----	32,150	1,700	102,500	-----	-----	-----	300	-----	-----	-----	136,650
	9-13	Sk.	236	329	248	154	791	1,967	1,414	1,427	1,343	515	-----	-----	-----	8,424
		Wt.	74,000	61,000	30,300	13,200	77,400	215,600	142,100	156,266	104,216	24,467	-----	-----	-----	898,549
	14-18	Sk.	265	53	-----	-----	-----	-----	-----	-----	112	-----	183	-----	-----	927
		Wt.	46,557	10,500	-----	-----	-----	-----	-----	-----	22,500	45,878	27,000	-----	-----	152,435
	19-23	Sk.	908	433	-----	944	1,964	1,235	-----	-----	273	1,218	1,601	840	487	9,903
Wt.		325,060	99,843	-----	219,217	397,952	181,795	-----	-----	66,000	184,065	330,011	232,898	220,002	2,256,343	
24-28	Sk.	456	165	1,166	445	-----	448	765	-----	695	-----	-----	-----	-----	4,140	
	Wt.	86,587	13,410	176,252	54,202	-----	51,045	123,176	-----	86,550	-----	-----	-----	-----	591,222	
Total	Sk.	1,865	980	1,414	1,905	2,813	4,222	2,179	2,395	2,673	2,454	1,023	487	-----	24,410	
	Wt.	532,204	184,753	206,552	318,769	477,052	550,940	265,276	308,816	310,781	400,656	259,898	220,002	-----	4,035,699	
1917	1-8	Sk.	-----	-----	-----	532	807	286	-----	-----	-----	-----	-----	-----	1,625	
		Wt.	-----	-----	-----	36,900	42,200	31,400	-----	-----	-----	-----	-----	-----	-----	110,500
	9-13	Sk.	125	349	871	450	1,594	1,786	2,252	2,169	832	72	-----	-----	58	10,558
		Wt.	18,000	53,000	46,140	33,150	128,300	137,930	204,950	198,500	55,100	3,350	-----	-----	11,000	889,420
	14-18	Sk.	-----	244	80	405	-----	260	273	-----	45	42	-----	-----	-----	1,349
		Wt.	-----	25,000	6,400	27,776	-----	19,000	15,000	-----	10,000	4,000	-----	-----	-----	107,176
	19-23	Sk.	211	323	971	1,464	616	252	42	633	1,397	345	1,224	923	-----	8,401
Wt.		26,030	39,017	113,308	223,646	66,103	13,000	3,000	59,225	177,476	71,000	281,966	258,500	-----	1,332,271	
24-28	Sk.	-----	-----	-----	508	721	2,447	870	783	-----	340	211	-----	-----	5,380	
	Wt.	-----	-----	-----	121,590	52,334	440,840	77,482	104,795	-----	68,000	57,000	-----	-----	922,041	
Total	Sk.	336	916	1,922	3,359	3,738	5,031	3,437	3,585	2,274	799	1,435	981	-----	27,813	
	Wt.	44,030	117,017	165,848	443,062	288,937	642,170	300,432	362,520	242,576	146,350	338,966	269,500	-----	3,361,408	
1918	1-8	Sk.	-----	-----	63	478	330	55	-----	66	423	153	87	8	1,663	
		Wt.	-----	-----	1,145	32,850	29,350	7,000	-----	1,700	42,150	11,610	2,115	200	-----	128,120
	9-13	Sk.	569	197	101	310	524	1,772	596	2,387	1,387	246	10	-----	-----	8,099
		Wt.	108,300	28,770	8,300	14,370	35,370	121,300	37,118	196,407	132,040	17,700	150	-----	-----	699,325
	14-18	Sk.	123	318	122	243	83	-----	16	17	-----	-----	-----	-----	-----	922
		Wt.	13,504	36,072	20,000	23,642	10,020	-----	1,600	1,900	-----	-----	-----	-----	-----	106,738
	19-23	Sk.	120	70	928	970	1,605	1,342	476	370	145	224	530	1,362	-----	8,192
Wt.		16,240	8,000	125,522	147,870	134,755	133,400	47,000	52,000	9,190	33,000	129,000	194,529	-----	1,030,506	
24-28	Sk.	-----	-----	480	890	2,752	596	168	480	-----	240	-----	-----	-----	5,606	
	Wt.	-----	-----	51,491	133,935	345,319	86,000	34,000	30,567	-----	18,000	-----	-----	-----	699,312	
Total	Sk.	812	585	1,694	2,891	5,294	3,765	1,256	3,320	1,955	863	677	1,370	-----	24,482	
	Wt.	138,044	72,842	206,458	352,667	554,814	347,700	119,718	282,574	183,380	80,310	131,265	194,729	-----	2,664,501	

APPENDIX A—(Continued).

Year	Area		January	February	March	April	May	June	July	August	September	October	November	December	Total	
1919	1-8	Sk.	-----	-----	-----	210	247	54	9	-----	54	-----	-----	-----	574	
		Wt.	-----	-----	-----	9,350	10,100	2,500	350	-----	300	-----	-----	-----	-----	22,600
	9-13	Sk.	184	482	659	1,796	865	1,007	1,725	1,727	579	539	-----	-----	-----	9,563
		Wt.	38,335	71,625	37,250	116,150	59,100	68,550	159,350	151,880	40,175	45,500	-----	-----	-----	787,915
	14-18	Sk.	100	158	477	491	90	-----	-----	-----	27	225	27	-----	-----	1,595
		Wt.	13,955	14,215	43,370	44,165	7,381	-----	-----	-----	3,700	27,700	800	-----	-----	155,286
	19-23	Sk.	919	301	189	443	829	2,925	1,971	1,979	528	1,049	694	709	-----	12,536
Wt.		252,000	33,000	14,000	49,700	95,972	253,838	188,300	213,000	42,000	119,000	220,037	270,000	-----	1,750,847	
24-28	Sk.	-----	-----	406	1,814	3,705	1,923	448	-----	663	-----	-----	-----	-----	8,959	
	Wt.	-----	-----	56,500	373,558	430,606	119,635	28,397	-----	33,328	-----	-----	-----	-----	1,042,024	
Total	Sk.	1,203	941	1,731	4,754	5,736	5,909	4,153	3,733	2,049	1,615	694	709	-----	33,227	
	Wt.	304,290	118,840	151,120	592,923	603,159	444,523	376,397	368,580	143,503	165,300	220,037	270,000	-----	3,753,672	
1920	1-8	Sk.	-----	-----	-----	-----	69	-----	-----	12	-----	18	3	-----	102	
		Wt.	-----	-----	-----	-----	4,300	-----	-----	1,300	-----	2,000	200	-----	7,800	
	9-13	Sk.	224	768	441	584	854	1,601	2,326	1,583	2,205	150	-----	-----	-----	10,736
		Wt.	40,000	66,356	28,700	36,700	60,200	117,600	170,250	143,700	211,822	8,800	-----	-----	-----	884,128
	14-18	Sk.	130	194	237	445	431	482	388	587	987	713	218	16	-----	4,823
		Wt.	11,765	23,000	32,200	47,158	31,540	27,851	32,600	43,284	113,024	44,362	14,563	4,000	-----	425,347
	19-23	Sk.	217	210	103	1,091	1,087	954	421	959	1,513	509	1,458	852	-----	9,374
Wt.		54,000	18,513	8,900	133,576	129,110	78,141	46,500	91,950	149,200	40,400	350,465	238,400	-----	1,339,155	
24-28	Sk.	-----	-----	1,772	2,188	2,234	1,824	1,301	447	528	56	108	-----	-----	10,458	
	Wt.	-----	-----	378,504	382,468	283,823	255,466	137,627	48,056	79,611	7,000	19,000	-----	-----	1,591,555	
29-36	Sk.	-----	-----	-----	-----	-----	-----	-----	-----	176	-----	232	-----	-----	408	
	Wt.	-----	-----	-----	-----	-----	-----	-----	-----	20,000	-----	43,602	-----	-----	63,602	
Total	Sk.	571	1,172	2,553	4,308	4,675	4,861	4,431	3,764	5,233	1,678	1,787	868	-----	35,901	
	Wt.	105,765	107,869	448,304	599,902	508,973	479,058	386,977	348,290	553,657	146,164	384,228	242,400	-----	4,311,587	
1921	1-8	Sk.	-----	-----	436	248	261	205	196	813	964	1,184	195	-----	4,502	
		Wt.	-----	-----	72,800	14,300	12,800	10,800	8,400	73,000	61,600	63,000	10,000	-----	326,700	
	9-13	Sk.	78	432	684	654	1,227	1,493	2,190	5,352	2,812	176	92	-----	-----	15,190
		Wt.	2,500	36,200	40,400	36,175	106,400	130,800	189,000	441,306	229,878	5,250	6,400	-----	-----	1,224,309
	14-18	Sk.	328	650	786	1,053	504	410	796	1,036	837	554	236	105	-----	7,295
		Wt.	32,350	45,895	69,400	85,435	34,130	31,997	45,067	61,560	36,745	25,391	15,125	41,000	-----	524,095
19-23	Sk.	133	286	304	334	832	253	1,515	779	54	1,885	1,622	1,181	-----	9,178	
	Wt.	20,500	33,500	33,200	31,900	70,150	16,692	191,172	110,300	4,000	290,600	449,500	375,500	-----	1,627,015	
24-28	Sk.	154	364	1,556	864	2,151	3,880	1,992	-----	895	-----	-----	-----	-----	11,856	
	Wt.	26,000	46,000	203,000	119,500	223,000	455,425	192,015	-----	94,000	-----	-----	-----	-----	1,353,940	

APPENDIX A—(Continued).

Year	Area		January	February	March	April	May	June	July	August	September	October	November	December	Total
1922	29-36	Sk. Wt.	----- -----	----- -----	----- -----	----- -----	679 98,694	----- -----	704 85,020	----- -----	----- -----	----- -----	----- -----	----- -----	1,383 183,714
	Total	Sk. Wt.	693 81,350	1,732 161,595	3,766 418,800	3,153 287,310	5,654 545,174	6,241 645,715	7,393 710,674	7,980 686,166	5,562 426,223	3,799 384,241	2,145 481,025	1,286 416,500	49,404 5,244,773
	1-8	Sk. Wt.	----- -----	----- -----	113 3,500	208 20,000	230 15,300	388 16,800	191 7,050	142 3,300	250 12,300	471 25,100	----- -----	----- -----	1,993 103,350
	9-13	Sk. Wt.	150 6,950	593 45,950	924 55,580	988 44,000	1,342 84,630	2,829 209,582	2,886 220,320	3,169 192,112	1,669 97,870	448 27,090	278 23,450	----- -----	15,276 1,007,534
	14-18	Sk. Wt.	428 29,560	776 52,890	659 38,699	606 31,800	873 44,780	808 51,728	1,950 121,255	1,231 76,920	1,767 107,288	1,484 78,537	459 28,720	28 950	11,069 663,127
	19-23	Sk. Wt.	300 52,500	42 4,000	750 74,250	555 56,800	606 55,700	714 52,900	856 88,000	362 20,000	602 69,500	2,153 229,000	1,458 259,500	2,979 619,000	11,377 1,581,150
	24-28	Sk. Wt.	----- -----	284 55,000	1,080 123,500	1,761 236,500	2,765 422,200	2,037 244,000	2,209 240,000	791 107,000	1,632 210,000	435 70,000	295 45,000	----- -----	13,289 1,753,200
	29-36	Sk. Wt.	----- -----	----- -----	----- -----	----- -----	----- -----	----- -----	----- -----	----- -----	118 7,000	----- -----	----- -----	----- -----	118 7,000
	Total	Sk. Wt.	878 89,010	1,695 157,840	3,526 295,529	4,118 389,100	5,816 622,610	6,776 575,010	8,092 676,625	5,695 399,332	6,038 503,958	4,991 429,727	2,490 356,670	3,007 619,950	53,122 5,115,361
	1923	1-8	Sk. Wt.	----- -----	85 2,500	564 19,000	523 18,900	419 15,800	555 19,700	878 37,400	237 4,700	181 5,300	599 22,000	438 13,300	----- -----	4,479 153,600
9-13		Sk. Wt.	276 10,900	445 28,335	1,425 82,545	1,383 58,034	2,396 140,290	4,439 246,830	3,646 217,070	6,068 351,970	1,832 118,780	667 26,255	120 1,890	----- -----	22,697 1,282,399
14-18		Sk. Wt.	645 69,400	1,380 112,260	1,699 117,960	1,006 67,210	555 37,315	1,137 61,115	1,722 124,545	1,271 64,955	905 49,335	817 45,390	----- -----	----- -----	11,137 749,485
19-23		Sk. Wt.	1,190 228,000	689 65,600	1,219 163,000	990 88,600	752 89,000	728 54,200	1,255 158,000	1,033 98,200	739 73,900	1,306 174,000	2,286 599,300	1,609 468,800	13,796 2,260,600
24-28		Sk. Wt.	----- -----	256 64,500	778 138,000	2,277 341,800	2,621 325,700	1,170 124,300	2,060 292,423	4,322 494,463	1,117 123,153	923 219,000	330 62,754	----- -----	15,854 2,186,093
29-36		Sk. Wt.	----- -----	----- -----	----- -----	----- -----	168 17,000	546 92,000	256 45,000	----- -----	----- -----	----- -----	----- -----	----- -----	970 154,000
Total		Sk. Wt.	2,111 308,300	2,855 273,195	5,685 520,505	6,179 574,544	6,911 625,105	8,575 598,145	9,817 874,438	12,931 1,014,288	4,774 370,468	4,312 486,645	3,174 677,244	1,609 468,800	68,933 6,791,677

APPENDIX A—(Continued).

Year	Area		January	February	March	April	May	June	July	August	September	October	November	December	Total
1924	1-8	Sk.	-----	50	370	825	441	230	43	103	318	378	-----	-----	2,758
		Wt.	-----	2,200	14,650	22,450	11,580	4,550	800	3,700	9,350	7,750	-----	-----	77,030
	9-13	Sk.	139	579	1,613	1,696	3,530	4,426	4,334	3,806	1,953	612	76	-----	22,764
		Wt.	20,000	54,600	93,910	76,085	196,580	248,540	237,322	234,550	111,790	32,375	2,500	-----	1,308,252
	14-18	Sk.	484	804	994	1,008	1,064	897	1,328	1,155	967	830	328	-----	9,859
		Wt.	55,400	61,500	66,772	60,340	71,722	49,900	70,205	63,818	37,285	33,859	17,570	-----	588,371
	19-23	Sk.	1,241	250	1,252	1,716	1,737	1,528	1,450	2,486	2,171	1,537	1,870	-----	17,238
		Wt.	269,900	28,800	119,400	173,200	135,695	137,370	82,323	196,377	161,445	121,500	235,200	-----	1,661,210
24-28	Sk.	-----	293	2,458	2,920	4,079	5,575	5,377	6,186	3,019	2,683	2,208	-----	34,798	
	Wt.	-----	52,000	387,728	377,798	380,662	594,100	566,378	719,477	334,000	323,400	280,300	-----	4,015,843	
29-36	Sk.	-----	-----	-----	-----	163	956	531	822	573	-----	-----	-----	3,045	
	Wt.	-----	-----	-----	-----	17,000	123,000	56,000	109,000	61,000	-----	-----	-----	-----	366,000
Total	Sk.	1,864	1,976	6,687	8,165	11,014	13,612	13,063	14,558	9,001	6,040	4,482	-----	90,462	
	Wt.	345,300	199,100	682,460	709,873	813,239	1,157,460	1,013,028	1,326,922	714,870	518,884	535,570	-----	8,016,706	
1925	1-8	Sk.	-----	88	777	455	103	356	53	62	116	529	276	-----	2,815
		Wt.	-----	3,800	22,900	15,000	3,100	9,150	1,350	800	3,300	22,599	21,500	-----	103,499
	9-13	Sk.	-----	401	2,183	2,297	4,957	2,678	3,111	3,949	2,224	702	238	-----	22,740
		Wt.	-----	17,000	97,140	104,785	228,390	112,250	175,955	279,080	125,005	34,693	13,820	-----	1,188,118
	14-18	Sk.	-----	1,253	1,138	1,467	1,855	1,177	2,525	2,300	1,154	1,506	241	-----	14,616
		Wt.	-----	68,164	66,700	82,535	107,225	72,186	124,235	123,800	52,050	78,373	15,600	-----	790,868
	19-23	Sk.	-----	1,573	1,318	2,679	2,774	2,002	1,196	2,030	2,328	1,849	1,232	-----	18,981
		Wt.	-----	171,780	135,200	203,068	177,725	113,434	65,300	127,300	145,398	144,800	137,100	-----	1,421,105
24-28	Sk.	-----	2,462	4,571	5,055	7,510	4,224	3,222	5,717	5,138	4,826	1,573	-----	44,298	
	Wt.	-----	467,500	781,600	507,997	551,270	323,950	259,200	614,700	455,464	411,800	188,500	-----	4,561,981	
29-36	Sk.	-----	-----	-----	235	1,337	3,501	4,790	3,081	869	502	250	-----	14,565	
	Wt.	-----	-----	-----	20,000	124,000	369,250	503,600	255,400	75,200	55,000	27,000	-----	1,429,450	
Total	Sk.	-----	5,777	9,987	12,188	18,536	13,938	14,897	17,139	11,829	9,914	3,810	-----	118,015	
	Wt.	-----	728,244	1,103,540	933,385	1,191,710	1,000,220	1,129,640	1,401,080	856,417	747,265	403,520	-----	9,495,021	
1926	1-8	Sk.	-----	349	1,170	925	393	588	690	113	576	665	140	-----	5,609
		Wt.	-----	8,715	43,235	49,100	15,100	17,092	26,750	3,200	16,200	22,404	7,100	-----	208,896
	9-13	Sk.	-----	2,271	14,670	14,442	12,217	14,791	14,874	9,120	5,551	2,415	773	-----	91,124
		Wt.	-----	104,965	695,090	617,460	538,531	831,095	801,949	466,404	255,195	109,720	34,810	-----	4,455,219
	14-18	Sk.	-----	5,366	8,028	8,522	6,566	9,044	5,963	6,824	4,565	1,413	608	-----	56,899
Wt.		-----	328,175	431,864	539,230	391,622	492,605	346,700	433,040	296,695	61,075	36,930	-----	3,357,936	
19-23	Sk.	-----	1,974	3,440	5,057	4,506	3,058	3,062	4,147	1,364	1,832	2,292	-----	30,732	
	Wt.	-----	170,150	239,000	368,915	344,660	225,760	213,300	233,450	89,100	163,300	299,800	-----	2,347,435	

APPENDIX A—(Continued).

Year	Area		January	February	March	April	May	June	July	August	September	October	November	December	Total	
1927	24-28	Sk.	-----	8,709	11,787	13,704	10,927	7,155	6,314	15,324	13,586	7,726	1,428	-----	96,660	
		Wt.	-----	1,361,145	1,270,577	1,278,500	865,975	701,000	605,000	1,373,680	1,141,400	629,650	137,100	-----	9,364,027	
	29-36	Sk.	-----	-----	1,277	3,091	7,073	8,514	5,465	5,560	2,837	327	-----	-----	34,144	
		Wt.	-----	-----	131,300	329,900	798,835	844,984	525,335	533,600	298,600	30,000	-----	-----	3,492,554	
	Total	Sk.	-----	18,669	40,372	45,741	41,682	43,150	36,368	41,088	28,479	14,378	5,241	-----	315,168	
		Wt.	-----	1,973,150	2,811,066	3,183,105	2,954,723	3,112,536	2,519,034	3,043,374	2,097,190	1,016,149	515,740	-----	23,226,067	
	1928	1-8	Sk.	-----	-----	21	232	300	567	614	382	323	303	147	-----	2,889
			Wt.	-----	-----	441	5,800	7,800	13,282	23,700	9,600	9,635	24,350	11,800	-----	106,408
		9-13	Sk.	-----	1,223	6,480	8,568	9,110	10,031	9,338	7,097	4,804	2,687	951	-----	60,289
			Wt.	-----	47,495	278,841	315,621	366,930	480,360	473,406	393,202	270,820	137,000	44,475	-----	2,808,150
14-18		Sk.	-----	1,536	3,260	4,715	4,876	4,540	4,122	2,670	1,462	1,438	344	-----	28,963	
		Wt.	-----	98,551	166,740	280,350	278,591	271,450	258,200	117,076	67,270	79,850	17,017	-----	1,635,095	
19-23		Sk.	-----	367	1,138	3,124	5,850	2,753	2,246	3,205	3,216	4,461	5,766	-----	32,126	
		Wt.	-----	38,500	126,939	226,101	384,750	191,000	140,400	193,650	194,200	375,870	668,200	-----	2,539,610	
24-28		Sk.	-----	2,287	7,467	5,600	6,689	6,124	7,993	9,520	9,727	6,524	2,064	-----	63,995	
		Wt.	-----	326,200	846,591	420,528	505,620	542,600	725,355	771,570	727,835	385,885	211,784	-----	5,463,968	
29-36	Sk.	-----	270	1,005	3,046	7,021	4,648	4,165	5,640	4,121	1,476	208	-----	31,600		
	Wt.	-----	45,000	137,500	266,400	714,200	450,660	393,443	492,630	388,269	180,200	30,000	-----	3,098,302		
Total	Sk.	-----	5,683	19,371	25,285	33,846	28,663	28,478	28,514	23,653	16,889	9,480	-----	219,862		
	Wt.	-----	555,746	1,557,052	1,514,800	2,257,891	1,949,352	2,014,504	1,977,728	1,658,029	1,183,155	983,276	-----	15,651,533		
1928	1-8	Sk.	-----	295	288	1,187	2,952	2,894	988	1,842	2,629	2,211	204	-----	15,490	
		Wt.	-----	4,450	10,941	33,115	114,750	85,700	37,121	45,370	63,479	85,925	3,100	-----	483,951	
	9-13	Sk.	-----	4,760	8,323	13,605	15,341	18,150	16,126	17,299	8,836	6,012	1,520	-----	109,972	
		Wt.	-----	259,010	372,913	646,405	703,164	883,937	919,971	845,395	381,980	215,985	75,720	-----	5,304,480	
	14-18	Sk.	-----	2,173	3,532	4,755	4,377	5,493	3,992	4,556	4,206	3,350	1,206	-----	37,640	
		Wt.	-----	165,200	224,830	250,093	263,100	246,961	196,850	234,050	181,961	167,003	85,223	-----	2,015,271	
	19-23	Sk.	-----	2,760	2,544	7,323	8,717	5,558	3,380	5,147	6,223	8,879	6,893	-----	57,424	
		Wt.	-----	252,125	223,335	490,219	486,200	313,550	229,964	312,792	343,300	540,844	579,433	-----	3,771,762	
	24-28	Sk.	-----	6,493	9,423	7,289	9,609	12,232	12,995	17,801	16,401	13,730	2,432	-----	108,405	
		Wt.	-----	828,188	811,076	469,064	709,059	854,447	956,287	1,192,175	1,037,845	1,001,112	193,800	-----	8,053,053	
29-36	Sk.	-----	990	1,791	7,078	6,951	5,272	5,869	5,465	2,088	1,222	-----	-----	36,726		
	Wt.	-----	120,873	192,874	606,684	471,601	444,150	414,200	398,124	173,110	92,995	-----	-----	2,914,611		
Total	Sk.	-----	17,471	25,901	41,237	47,947	49,599	43,350	52,110	40,383	35,404	12,255	-----	365,657		
	Wt.	-----	1,629,846	1,835,969	2,495,580	2,747,874	2,828,745	2,754,393	3,027,906	2,181,675	2,103,864	937,276	-----	22,543,128		

APPENDIX B.

TABLE 1.—Number of sets of 6-line skates, and total catch in pounds, by area for each month of 1926.

Area		February	March	April	May	June	July	August	September	October	November	Total
1	Sk.	-----	-----	-----	-----	303	-----	-----	-----	-----	-----	303
	Wt.	-----	-----	-----	-----	5,392	-----	-----	-----	-----	-----	5,392
2	Sk.	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
	Wt.	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
3	Sk.	-----	15	-----	-----	-----	-----	-----	-----	171	140	326
	Wt.	-----	50	-----	-----	-----	-----	-----	-----	6,950	7,100	14,100
4	Sk.	-----	-----	500	250	-----	-----	-----	12	-----	-----	762
	Wt.	-----	-----	21,100	10,500	-----	-----	-----	200	-----	-----	31,800
5	Sk.	-----	429	207	-----	-----	640	18	369	359	-----	2,022
	Wt.	-----	15,000	12,500	-----	-----	23,750	200	8,700	12,554	-----	72,704
6	Sk.	100	156	15	27	122	-----	39	15	93	-----	567
	Wt.	2,235	4,160	500	500	7,800	-----	600	500	2,200	-----	18,495
7	Sk.	233	561	203	116	163	50	-----	180	42	-----	1,548
	Wt.	6,280	23,725	15,000	4,100	3,900	3,000	-----	6,800	700	-----	63,505
8	Sk.	16	9	-----	-----	-----	-----	56	-----	-----	-----	81
	Wt.	200	300	-----	-----	-----	-----	2,400	-----	-----	-----	2,900
9	Sk.	372	926	447	279	240	920	647	195	299	-----	4,325
	Wt.	11,050	36,700	22,680	8,000	17,000	53,400	20,500	5,700	34,250	-----	209,280
10	Sk.	177	2,862	2,020	329	1,854	970	678	616	170	160	9,836
	Wt.	8,250	154,400	100,370	11,961	111,150	43,950	25,755	17,160	7,450	9,200	489,646
11	Sk.	703	2,758	2,251	1,434	4,218	4,039	2,723	1,070	214	-----	19,410
	Wt.	30,890	150,340	112,980	66,430	228,695	238,474	131,979	46,430	5,900	-----	1,012,118
12	Sk.	214	1,831	3,076	4,579	4,091	2,223	1,524	1,000	473	122	19,133
	Wt.	5,975	73,115	112,080	186,575	224,725	105,930	88,630	57,800	15,475	6,400	876,705
13	Sk.	806	6,293	6,648	5,596	4,388	6,721	3,547	2,671	1,259	491	38,420
	Wt.	48,800	280,535	269,350	265,565	249,525	360,195	199,540	128,105	46,645	19,210	1,867,470
14	Sk.	387	1,229	873	897	2,436	1,932	1,615	1,480	456	-----	11,305
	Wt.	17,203	49,750	44,280	49,467	140,650	110,850	100,450	79,900	20,900	-----	613,450
15	Sk.	835	2,260	2,437	2,438	4,138	2,383	2,716	1,803	432	-----	19,442
	Wt.	37,365	117,955	161,700	182,000	237,185	154,400	194,850	144,325	20,070	-----	1,249,850
16	Sk.	1,891	2,158	3,119	2,512	1,873	346	814	313	159	204	13,389
	Wt.	122,607	141,455	203,900	126,725	89,755	13,250	53,400	13,100	6,405	12,650	783,247

APPENDIX B—(Continued).

Area		February	March	April	May	June	July	August	September	October	November	Total
17	Sk.	799	934	621	396	369	593	624	451	260	404	5,451
	Wt.	54,500	40,004	32,900	18,580	13,415	25,500	32,380	23,060	7,400	24,280	272,019
18	Sk.	1,454	1,446	1,472	323	229	709	1,055	518	106	.....	7,312
	Wt.	96,500	82,700	96,450	14,850	11,600	42,700	51,960	36,310	6,300	.....	439,370
19	Sk.	745	1,700	2,580	396	120	350	240	55	145	.....	6,331
	Wt.	56,450	123,600	157,350	22,700	3,750	19,700	10,200	4,300	13,800	.....	411,850
20.	Sk.	176	1,581	1,131	2,042	785	2,120	3,228	745	572	506	12,886
	Wt.	16,700	103,400	82,565	153,860	72,360	151,400	178,750	52,000	46,500	104,500	962,035
21	Sk.	810	46	350	805	1,063	378	95	172	898	1,213	5,830
	Wt.	76,200	4,900	36,400	65,200	77,050	25,800	4,500	5,500	67,500	126,800	489,850
22	Sk.	239	54	633	658	217	25	.....	300	42	573	2,741
	Wt.	20,700	3,500	63,300	57,200	8,500	100	.....	24,200	6,000	68,500	252,000
23	Sk.	4	59	363	605	873	189	584	91	176	.....	2,944
	Wt.	100	3,600	29,300	45,700	64,100	16,300	40,000	3,100	29,500	.....	231,700
24	Sk.	806	1,851	1,785	1,416	689	404	307	819	987	428	9,492
	Wt.	125,500	147,400	149,000	103,675	64,600	32,000	18,300	61,000	78,434	35,500	815,409
25	Sk.	2,962	4,350	5,577	3,507	995	756	2,825	2,489	1,679	221	25,361
	Wt.	382,870	515,000	618,200	289,850	98,750	78,850	247,100	188,400	166,433	16,600	2,602,053
26	Sk.	3,694	4,374	3,340	4,053	2,498	1,414	4,814	4,872	1,777	421	31,257
	Wt.	665,500	481,877	299,500	341,050	240,750	180,350	505,280	410,700	148,933	51,500	3,325,440
27	Sk.	969	226	1,106	950	1,083	1,910	3,301	2,556	1,737	.....	13,838
	Wt.	172,375	20,000	103,900	66,700	126,500	160,200	255,550	232,400	137,300	.....	1,274,925
28	Sk.	277	986	1,897	1,001	1,890	1,830	4,078	2,850	1,545	358	16,712
	Wt.	14,900	106,300	107,900	64,700	170,400	153,600	347,450	248,900	98,550	33,500	1,346,200
29	Sk.	.....	1,061	1,897	2,590	3,671	2,299	3,569	2,591	327	.....	18,005
	Wt.	.....	110,300	237,800	258,300	378,600	220,085	348,300	268,000	30,000	.....	1,851,385
30	Sk.	.....	.....	741	676	3,379	1,866	1,275	196	.....	.....	8,133
	Wt.	.....	.....	55,100	83,100	341,384	203,050	116,900	29,000	.....	.....	828,534
31	Sk.	.....	216	162	2,732	590	.....	397	.....	.....	.....	4,097
	Wt.	.....	21,000	13,200	328,935	50,000	.....	42,400	.....	.....	.....	455,535
32	Sk.	.....	.....	291	664	874	537	.....	15	.....	.....	2,381
	Wt.	.....	.....	23,800	74,000	75,000	31,500	.....	600	.....	.....	204,900
33	Sk.	.....	.....	.....	410	.....	690	319	35	.....	.....	1,454
	Wt.	.....	.....	.....	54,500	.....	65,950	26,000	1,000	.....	.....	147,450
34	Sk.	.....	.....	.....	.....	.....	73	.....	.....	.....	.....	73
	Wt.	.....	.....	.....	.....	.....	4,750	.....	.....	.....	.....	4,750
Total	Sk.	18,669	40,371	45,742	41,681	43,151	36,367	41,088	28,479	14,378	5,241	315,167
	Wt.	1,973,150	2,811,066	3,183,105	2,954,723	3,112,536	2,519,034	3,043,374	2,097,190	1,016,149	515,740	23,226,067

APPENDIX B,—(Continued).

TABLE 2.—Number of sets of 6-line skates, and total catch in pounds, by area for each month of 1927.

Area		February	March	April	May	June	July	August	September	October	November	Total
1	Sk.	.....	.....	.....	.....	48	.....	.....	.....	.....	.....	48
	Wt.	.....	.....	.....	.....	112	.....	.....	.....	.....	.....	112
2	Sk.	.....	.....	.....	.....	10	.....	.....	.....	.....	.....	10
	Wt.	.....	.....	.....	.....	60	.....	.....	.....	.....	.....	60
3	Sk.	.....	.....	.....	.....	30	.....	.....	215	285	147	677
	Wt.	.....	.....	.....	.....	110	.....	.....	6,895	24,150	11,800	42,955
4	Sk.	.....	.....	.....	.....	.....	.....	.....	24	18	.....	42
	Wt.	.....	.....	.....	.....	.....	.....	.....	1,300	200	.....	1,500
5	Sk.	.....	8	.....	.....	129	77	.....	48	.....	.....	262
	Wt.	.....	168	.....	.....	3,100	3,100	.....	1,200	.....	.....	7,568
6	Sk.	.....	.....	12	24	73	492	382	36	.....	.....	1,019
	Wt.	.....	.....	100	400	1,000	19,400	9,600	240	.....	.....	30,740
7	Sk.	.....	13	220	276	180	.....	.....	.....	.....	.....	689
	Wt.	.....	273	5,700	7,400	4,300	.....	.....	.....	.....	.....	17,673
8	Sk.	.....	.....	.....	.....	97	45	.....	.....	.....	.....	142
	Wt.	.....	.....	.....	.....	4,600	1,200	.....	.....	.....	.....	5,800
9	Sk.	52	403	404	194	524	500	955	767	368	310	4,477
	Wt.	1,250	17,460	8,163	7,150	42,100	25,500	53,050	25,320	21,900	16,500	218,393
10	Sk.	63	780	1,470	1,028	1,519	1,889	1,014	724	267	118	8,872
	Wt.	3,100	35,273	53,133	44,750	58,000	88,145	39,190	47,900	12,530	2,350	384,371
11	Sk.	506	1,580	1,600	1,528	2,949	2,231	1,648	1,195	459	6	13,702
	Wt.	21,060	86,223	67,883	72,146	118,822	128,824	127,644	79,075	28,967	50	730,694
12	Sk.	120	1,009	2,511	2,478	1,918	1,958	1,136	20	95	83	11,328
	Wt.	6,700	45,490	83,158	86,237	98,975	99,808	62,850	1,000	5,200	3,500	492,718
13	Sk.	482	2,708	2,583	3,882	3,121	2,760	2,344	2,098	1,498	434	21,910
	Wt.	15,385	94,395	103,284	156,647	162,463	131,329	110,468	117,525	68,403	22,075	981,974
14	Sk.	127	619	355	493	530	697	822	413	545	86	4,687
	Wt.	3,250	23,400	14,312	23,688	24,400	52,500	43,563	23,105	36,895	3,100	248,213
15	Sk.	509	692	1,332	2,355	2,224	2,065	1,121	359	606	202	11,465
	Wt.	22,700	25,640	103,238	151,853	160,100	140,800	47,913	12,965	32,605	9,450	707,264
16	Sk.	203	491	1,731	819	950	249	229	134	86	14	4,906
	Wt.	14,367	37,300	99,200	40,100	44,750	12,300	5,950	4,400	1,950	300	260,617

APPENDIX B—(Continued).

Area		February	March	April	May	June	July	August	September	October	November	Total
17	Sk.	406	567	529	497	124	748	181	328	178	-----	3,558
	Wt.	29,567	23,550	24,000	23,100	5,500	35,700	6,400	17,200	6,350	-----	171,367
18	Sk.	291	891	768	712	712	363	317	228	23	42	4,347
	Wt.	23,667	56,850	39,600	39,850	36,700	16,900	13,250	9,600	2,050	4,167	247,634
19	Sk.	68	270	1,801	2,183	1,011	395	1,364	899	511	163	8,665
	Wt.	4,500	22,300	134,567	146,900	59,500	19,050	73,050	46,600	39,050	12,967	558,484
20	Sk.	-----	427	703	1,602	943	835	515	1,137	819	837	7,818
	Wt.	-----	49,600	38,667	103,150	71,750	49,250	16,000	46,300	55,500	83,467	513,634
21	Sk.	118	441	136	1,243	280	442	383	709	2,306	3,076	9,134
	Wt.	16,500	55,039	6,867	64,350	13,650	22,200	33,200	40,200	187,410	355,733	795,149
22	Sk.	181	-----	275	196	151	240	145	235	513	1,375	3,311
	Wt.	17,500	-----	20,800	12,650	16,000	12,500	7,350	11,000	58,900	177,700	334,400
23	Sk.	-----	-----	209	626	368	334	798	236	312	315	3,198
	Wt.	-----	-----	25,200	57,700	30,100	37,400	64,050	50,100	35,010	38,333	337,893
24	Sk.	337	1,576	1,129	735	372	42	190	1,150	1,484	377	7,392
	Wt.	53,300	184,000	96,700	72,950	22,600	1,500	11,400	97,400	28,245	37,334	605,429
25	Sk.	838	3,304	1,955	1,369	1,199	670	1,677	2,773	2,364	1,182	17,331
	Wt.	95,600	318,641	155,226	69,038	97,500	51,868	105,550	217,350	159,290	128,450	1,398,513
26	Sk.	547	1,084	635	1,008	1,408	4,170	2,256	1,745	1,470	317	14,640
	Wt.	72,600	122,200	31,602	65,132	134,950	426,895	242,320	149,900	100,500	31,000	1,377,099
27	Sk.	339	593	789	2,238	1,302	1,617	2,218	1,718	686	188	11,688
	Wt.	61,100	77,450	61,600	186,600	96,900	118,782	165,200	122,900	67,850	15,000	973,382
28	Sk.	226	909	1,092	1,339	1,843	1,494	3,179	2,341	520	-----	12,943
	Wt.	43,600	144,300	75,400	111,900	190,650	126,310	247,100	140,285	30,000	-----	1,109,545
29	Sk.	270	1,005	1,514	1,028	882	422	1,680	2,027	733	208	9,769
	Wt.	45,000	137,500	113,450	83,850	62,500	23,644	159,530	185,685	81,700	30,000	922,859
30	Sk.	-----	-----	1,135	2,245	1,778	1,933	2,982	2,094	743	-----	12,910
	Wt.	-----	-----	125,700	186,850	204,610	206,667	267,100	202,584	98,500	-----	1,292,011
31	Sk.	-----	-----	184	764	256	880	-----	-----	-----	-----	2,084
	Wt.	-----	-----	13,000	80,500	22,050	84,666	-----	-----	-----	-----	200,216
32	Sk.	-----	-----	213	2,985	949	867	705	-----	-----	-----	5,719
	Wt.	-----	-----	14,250	363,000	75,500	73,466	53,500	-----	-----	-----	579,716
33	Sk.	-----	-----	-----	-----	-----	31	137	-----	-----	-----	168
	Wt.	-----	-----	-----	-----	-----	2,500	6,250	-----	-----	-----	8,750
34	Sk.	-----	-----	-----	-----	783	32	136	-----	-----	-----	951
	Wt.	-----	-----	-----	-----	86,000	2,500	6,250	-----	-----	-----	94,750
Total	Sk.	5,683	19,370	25,285	33,847	28,663	28,478	28,514	23,653	16,889	9,480	219,862
	Wt.	555,746	1,557,052	1,514,800	2,257,891	1,949,352	2,014,504	1,977,728	1,658,029	1,183,155	983,276	15,651,533

APPENDIX B,—(Continued).

TABLE 3.—Number of sets of 6-line skates, and total catch in pounds, by area for each month of 1928.

Area		February	March	April	May	June	July	August	September	October	November	Total
1	Sk.	44	-----	-----	-----	-----	-----	-----	583	188	-----	815
	Wt.	110	-----	-----	-----	-----	-----	-----	12,700	6,300	-----	19,110
2	Sk.	197	-----	-----	-----	-----	-----	294	410	421	-----	1,322
	Wt.	1,310	-----	-----	-----	-----	-----	2,620	4,319	13,500	-----	21,749
3	Sk.	12	-----	-----	-----	-----	-----	-----	173	798	27	1,010
	Wt.	30	-----	-----	-----	-----	-----	-----	4,250	45,900	1,600	51,780
4	Sk.	-----	-----	-----	-----	-----	-----	-----	-----	123	-----	123
	Wt.	-----	-----	-----	-----	-----	-----	-----	-----	1,325	-----	1,325
5	Sk.	-----	96	290	62	502	52	-----	6	245	177	1,430
	Wt.	-----	3,280	7,800	1,250	17,400	1,050	-----	100	8,000	1,500	40,380
6	Sk.	-----	12	643	2,075	1,885	801	487	449	60	-----	6,412
	Wt.	-----	100	19,315	79,187	52,300	32,991	5,125	4,160	1,000	-----	194,178
7	Sk.	-----	28	47	325	225	69	489	309	116	-----	1,608
	Wt.	-----	375	1,125	12,413	7,350	1,457	15,625	8,125	2,250	-----	48,720
8	Sk.	42	152	207	490	282	66	572	698	260	-----	2,769
	Wt.	3,000	7,186	4,875	21,900	8,650	1,623	22,000	29,825	7,650	-----	106,709
9	Sk.	565	1,091	1,732	1,237	1,074	1,052	1,400	1,045	1,885	223	11,304
	Wt.	28,500	57,000	96,800	55,905	42,500	53,900	61,050	58,050	70,500	4,900	529,105
10	Sk.	641	906	1,635	2,216	3,738	3,186	3,857	1,303	242	90	17,814
	Wt.	43,350	58,100	86,400	117,888	186,236	170,147	180,200	51,375	7,500	1,400	902,516
11	Sk.	1,119	1,221	1,279	2,230	3,434	5,923	3,588	695	169	12	19,670
	Wt.	60,250	57,945	56,750	83,248	199,695	312,310	154,970	25,335	4,970	500	955,973
12	Sk.	867	1,134	4,083	3,910	2,940	2,710	1,971	532	95	-----	18,242
	Wt.	48,150	43,450	178,480	149,369	140,100	118,006	88,490	17,945	3,065	-----	787,055
13	Sk.	1,567	3,971	4,876	5,748	6,964	3,256	6,483	5,260	3,621	1,196	42,942
	Wt.	78,760	156,418	227,975	296,754	315,406	265,608	360,685	229,275	129,950	68,920	2,129,751
14	Sk.	181	342	233	529	1,290	483	1,332	1,427	817	18	6,652
	Wt.	7,000	17,630	11,680	35,900	45,084	20,950	67,100	62,016	40,844	400	308,604
15	Sk.	273	177	1,080	1,264	885	1,144	745	861	1,024	541	7,994
	Wt.	17,200	6,350	52,300	90,050	34,763	65,200	48,450	39,218	45,600	33,650	432,781
16	Sk.	639	1,435	1,383	1,111	1,150	1,643	1,083	835	611	361	10,251
	Wt.	54,100	90,550	78,150	58,350	57,178	77,450	47,650	34,750	26,100	21,550	545,828
17	Sk.	382	721	566	447	723	177	281	778	359	103	4,537
	Wt.	33,250	46,550	26,950	16,900	39,000	6,500	12,050	32,550	15,250	3,750	232,750
18	Sk.	698	858	1,493	1,026	1,444	545	1,115	305	539	183	8,206
	Wt.	53,650	63,750	81,013	61,900	70,936	26,750	58,800	13,427	39,209	25,873	495,308

APPENDIX B—(Continued).

Area		February	March	April	May	June	July	August	September	October	November	Total
19	Sk. Wt.	555 51,900	1,122 106,650	2,646 185,144	3,327 182,700	1,837 89,300	516 30,864	817 26,500	809 39,662	183 10,150	179 11,800	11,991 734,670
20	Sk. Wt.	482 30,250	378 39,000	2,003 146,100	2,782 151,350	2,277 142,850	1,334 88,600	1,270 88,350	2,075 133,988	1,692 88,396	1,284 100,395	15,577 1,009,279
21	Sk. Wt.	905 79,650	600 52,750	1,596 91,475	1,059 64,800	511 22,900	333 22,800	1,554 83,540	1,861 78,400	4,179 267,981	2,946 225,858	15,544 990,154
22	Sk. Wt.	523 58,163	377 19,935	355 22,250	503 21,900	41 1,500	426 27,750	479 34,402	545 27,550	2,053 117,179	1,779 144,280	7,081 474,909
23	Sk. Wt.	295 32,162	67 5,000	723 45,250	1,046 65,450	892 57,000	771 59,950	1,027 80,000	934 63,700	772 57,138	705 97,100	7,232 562,750
24	Sk. Wt.	865 120,000	2,000 172,677	1,374 108,320	673 122,600	1,096 61,950	176 6,400	786 51,100	1,806 88,713	2,215 167,950	----- -----	10,991 899,710
25	Sk. Wt.	3,440 400,936	4,373 379,483	2,518 146,005	2,065 112,830	1,485 105,100	2,431 145,000	4,057 282,148	4,943 301,782	5,462 397,130	778 62,800	31,552 2,333,214
26	Sk. Wt.	1,508 196,305	1,590 138,745	1,131 81,405	3,692 250,662	4,839 345,630	3,980 301,116	5,118 347,372	3,352 218,550	1,768 124,632	540 41,750	27,518 2,046,167
27	Sk. Wt.	324 53,750	876 71,721	1,683 98,034	1,289 87,227	2,247 134,040	1,738 105,950	3,806 237,300	3,662 258,000	3,059 241,000	1,072 85,750	19,756 1,372,772
28	Sk. Wt.	357 57,197	585 48,450	582 35,300	1,890 135,740	2,566 207,727	4,670 397,821	4,033 274,255	2,639 170,800	1,227 70,400	42 3,500	18,591 1,401,190
29	Sk. Wt.	768 92,347	458 41,574	714 68,000	1,360 88,450	1,754 142,750	2,610 181,900	2,806 191,198	1,005 83,710	571 61,300	----- -----	12,046 951,229
30	Sk. Wt.	105 10,726	1,107 132,000	3,774 314,834	1,571 96,117	1,716 142,450	1,565 103,600	2,191 145,926	33 800	407 21,395	----- -----	12,469 967,848
31	Sk. Wt.	117 17,800	139 15,800	520 42,500	682 45,717	482 33,250	475 31,250	468 61,000	480 53,000	124 5,300	----- -----	3,487 305,617
32	Sk. Wt.	----- -----	15 400	1,928 172,850	2,864 195,217	803 71,700	554 54,250	----- -----	----- -----	120 5,000	----- -----	6,284 499,417
33	Sk. Wt.	----- -----	----- -----	142 8,500	211 25,000	487 52,000	298 21,500	----- -----	570 35,600	----- -----	----- -----	1,708 142,600
34	Sk. Wt.	----- -----	72 3,100	----- -----	257 21,000	----- -----	240 18,000	----- -----	----- -----	----- -----	----- -----	569 42,100
35	Sk. Wt.	----- -----	----- -----	----- -----	6 100	----- -----	10 400	----- -----	----- -----	----- -----	----- -----	16 500
36	Sk. Wt.	----- -----	----- -----	----- -----	----- -----	30 2,000	118 3,300	----- -----	----- -----	----- -----	----- -----	148 5,300
Total	Sk. Wt.	17,471 1,629,846	25,903 1,835,969	41,236 2,495,580	47,947 2,747,874	49,599 2,828,745	43,352 2,754,393	52,109 3,027,906	40,383 2,181,675	35,405 2,103,864	12,256 937,276	365,661 22,543,128