BULLETIN No. 121

The herring fishery of the Northwest Atlantic

By LESLIE W. SCATTERGOOD *and* S. N. TIBBO

PUBLISHED BY THE FISHERIES RESEARCH BOARD OF CANADA UNDER THE CONTROL OF THE HONOURABLE THE MINISTER OF FISHERIES

OTTAWA, 1959

Price: 75 cents

BULLETIN No. 121

The herring fishery of the Northwest Atlantic

By LESLIE W. SCATTERGOOD *and* S. N. TIBBO

PUBLISHED BY THE FISHERIES RESEARCH BOARD OF CANADA UNDER THE CONTROL OF THE HONOURABLE THE MINISTER OF FISHERIES

OTTAWA, 1959

74860-8—1

W. E. RICKER

N. M. CARTER

Editors

THE QUEEN'S PRINTER AND CONTROLLER OF STATIONERY
OTTAWA, 1960

Cat. No. Fs 94–121

BULLETINS OF THE FISHERIES RESEARCH BOARD OF CANADA are published from time to time to present popular and scientific information concerning fishes and some other aquatic animals; their environment and the biology of their stocks; means of capture; and the handling, processing and utilizing of fish and fishery products.

In addition, the Board publishes the following:

An ANNUAL REPORT of the work carried on under the direction of the Board.

The JOURNAL OF THE FISHERIES RESEARCH BOARD OF CANADA, containing the results of scientific investigations.

ATLANTIC PROGRESS REPORTS, consisting of brief articles on investigations by the Atlantic stations of the Board.

PACIFIC PROGRESS REPORTS, consisting of brief articles on investigations by the Pacific stations of the Board.

CENTRAL AREA PROGRESS REPORTS, consisting of brief articles on investigations by the Biological Station and Technological Unit, London, Ont.

The price of this Bulletin is 75 cents (Canadian funds, postpaid). Orders should be addressed to the Queen's Printer, Ottawa, Canada. Remittance made payable to the Receiver General of Canada should accompany the order.

All publications of the Fisheries Research Board of Canada still in print are available for purchase from the Queen's Printer. Bulletin No. 110 is an index and list of publications of the Board to the end of 1954 and is priced at 75 cents per copy postpaid.

For a listing of recent issues of the above publications see inside of back cover.

74860-8—2

CONTENTS

74860-8—2½

ABSTRACT

A general account is given of the history of the Northwest Atlantic fishery for herring (*Clupea harengus* L.) from aboriginal days to the present. The average catch during the last three decades has been 142,000 metric tons annually (313 million lb). About half of the catch is made on the Maine coast and in the Bay of Fundy; the Canadian Atlantic and the Gulf of St. Lawrence regions yield almost all of the remainder. The size of the catch seldom reflects the availability of the species in the fishing areas. Expansion of the fishery depends upon increased demand accompanied by a price that will make the fishery profitable. Offshore herring stocks, yet unfished, can be harvested, and new and better types of gear can be developed to yield greater catches.

INTRODUCTION

The sea herring (*Clupea harengus* L.) is one of the most abundant and important fishes in the North Atlantic. In Europe, the largest fisheries are in the Norwegian and North Seas. The species is taken commercially as far south as the Strait of Gibraltar. There are herring fisheries in Greenland, Iceland, and in the Arctic Ocean as far east as Siberia. In North America, herring are caught on the Atlantic shores from Labrador to Virginia; the principal fisheries are north of Cape Cod. In the western Atlantic, most of the herring are caught along the coasts; there are no offshore fisheries comparable to those of Europe.

In general, the North American herring fisheries are a series of localized operations of interest primarily to local fishermen and processors; however, in one important area, the fishery is of mutual concern to both Canada and the United

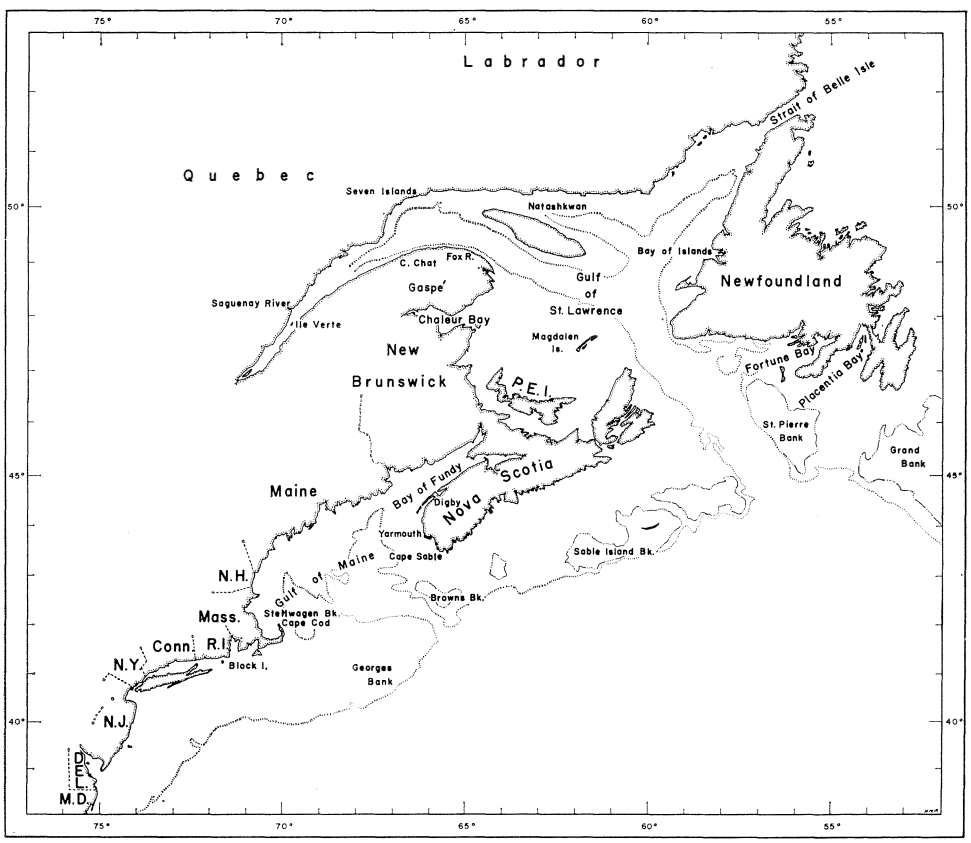


FIG. 1. Map of area showing provinces and states and principal localities mentioned.

States. Here, in a large region that includes the coasts of southern New Brunswick and all of Maine, the Canadian and United States processors of canned immature herring often depend upon a common supply of small herring or "sardines". Because of this joint interest in the availability of fish, scientists of the Fisheries Research Board of Canada and the United States Fish and Wildlife Service are cooperating to an increasing extent in biological studies of the herring in order to provide information that will be of value in utilizing the species to the best advantage.

The purpose of this paper is to offer a brief review of the herring fishery on the eastern shores of North America with particular reference to its present status. No such general summary has been made previously, and, consequently, few people in Canada and the United States have been familiar with the extent and utilization of the herring resources in both countries.

HISTORY OF THE FISHERY

Herring fisheries were well established in Europe many centuries before the discovery of America. Samuel (1918) has summarized the existing knowledge of their early development. Some have believed that herring fishing began at Yarmouth, England about 495 A.D. One of the earliest references is from the Evisham monastery chronicle in which the English herring fishery of the year 709 A.D. was mentioned. Another record indicates that in 836 A.D., the Dutch went to Scotland to buy salted fish—presumably herring. There are frequent references to Norwegian herring fisheries in the Icelandic sagas of the latter part of the tenth century, and there are records of a French herring fishery in the early eleventh century. It is apparent from these historical accounts that the early fishermen and colonists in North America may have been quite familiar with the methods of capturing and preserving herring.

The history of the herring fishery in the eastern parts of Canada and the United States is not as well documented as that in Europe. Not a great deal is known of the aboriginal fisheries prior to the visits of European fishermen about 450 years ago. The Indians had weirs, and herring as well as other shore fishes were probably taken in these rather simple forms of stationary gear

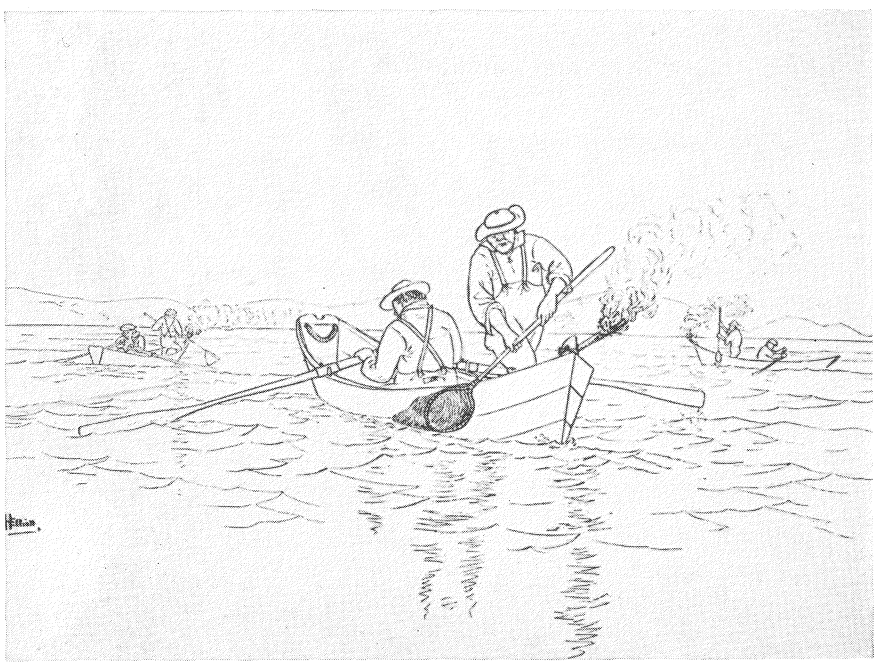


FIG. 2. Torching for herring at night in Ipswich Bay, Mass. (From sketch by J. S. Ryder about 1880.)

74860-8—3

(Earll, 1887). "Torching" (in some regions called "driving"), was also used by the aborigines, for this night method of fishing requires only a moving boat, a flaming torch to attract the herring to the water's surface, and a dip-net to capture the fish.

Fortunately, much information on the early history of the western Atlantic herring fishery can be inferred through the study of the somewhat better documented cod fishery, because herring was one of the principal baits for the long-lines and handlines that were used during the early cod fishery in Canada and the United States (Innis, 1954). As the North American fishery for cod developed, so did that for herring, because the Europeans found that at certain seasons herring suitable for bait could be caught in great numbers in the western Atlantic. Vessels fishing on the banks took many herring with gill nets set at night from the stern. Smith (1833) states that the first knowledge we have of the North American fisheries was in 1504 when the Newfoundland area was visited by French cod-fishing vessels. Portuguese and Spanish ships soon joined the fishing fleets, and by the middle of the sixteenth century the English were also sending fishing vessels to the eastern shores of the New World.

The eastern North American herring fishery, although never attaining the importance of that in Europe, played a definite role in the early economy of the coast areas of New England and the Maritime Provinces. During the seventeenth century, the French and English intensified their colonization of what is now Eastern Canada and the United States, and increasing amounts of herring were used as food. The colonists also entered the cod fisheries, and a thriving salt cod export trade was established. This greater cod-fishing activity undoubtedly increased the use of herring as bait.

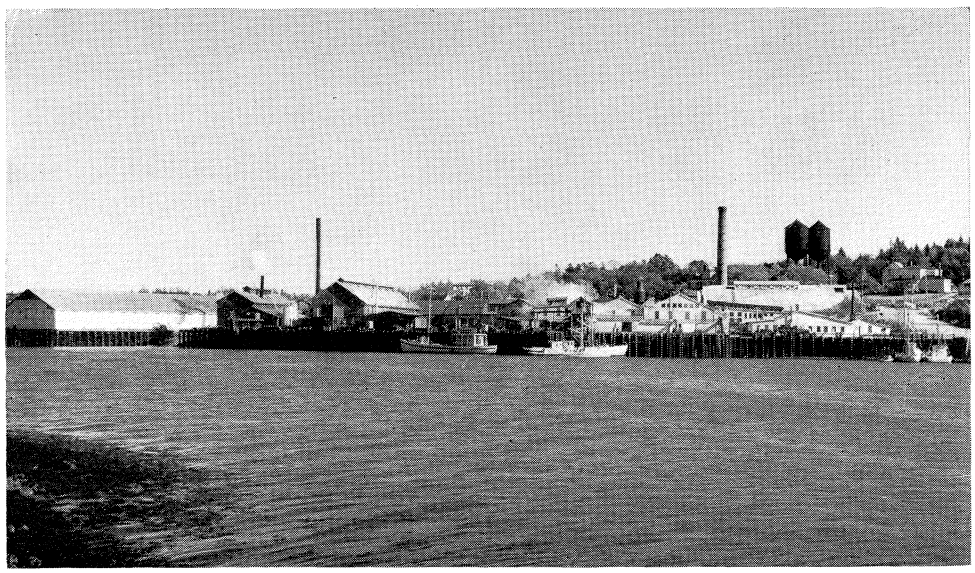


FIG. 3. A modern New Brunswick "sardine" cannery. (Photograph by P. W. G. McMullon, courtesy Connor's Bros. Limited, Black's Harbour, N.B.)

Herring were evidently plentiful in the early colonial days, for, speaking of these fish, Captain John Smith (1624) said ". . . the Saluages [savages] compare the store in the Sea with the haires of their heads; and surely there are an incredible abundance upon this coast". Josselyn (1675) reported that, during his visit in New England in 1670, herring were numerous and were taken all summer long. However, historical accounts of the fisheries, such as those by Josselyn (1675) and Sabine (1853), do not always make clear distinctions between the river herrings or alewives (*Pomolobus pseudoharengus* and *P. aestivalis*) and the sea herring (*Clupea harengus*).

FIG. 4. The interior of a Maine sardine cannery.
Top left: Removing sardines from the cookers.
Top right: Cutting and packing the fish.
Bottom left: A conveyor belt from the packers to sealing machine.
Bottom right: A sealing machine.

74860-8—3½

Before the end of the eighteenth century, United States fishing vessels had expanded their operating range from New England northward to the Canadian coasts. These vessels were engaged in the cod fishery on the Grand Bank of Newfoundland and later began operating in the Gulf of St. Lawrence and along the Labrador coast (Earll, 1887). Herring were caught for bait near the cod grounds.

During the early part of the nineteenth century, the demand for herring exceeded the supply available in United States waters, and New England vessels began buying herring at the Magdalen Islands, in the Gulf of St. Lawrence. These fish were salted or pickled and transported to Maine or Massachusetts where they were used for bait or reprocessed for food. During the 1850's, frozen herring were purchased in Newfoundland and brought to the United States to be used as bait for groundfishing. Later frozen herring were obtained from New Brunswick and Nova Scotia. By the latter part of the nineteenth century, the markets for salt herring had declined, and during the early years of the twentieth century, the groundfish longlining and handlining methods were being replaced by otter trawling, thus reducing the amounts of herring needed for bait. By the beginning of the twentieth century, few United States vessels were engaged in the salted, pickled, or frozen herring trade with Canada. Canadians still caught, preserved, and exported these fish, but to a declining market.

Two historically recent developments in the fisheries have led to an increased use of herring. One was the canning of young herring as sardines. This industry began in eastern Maine in the 1870's and later spread to neighbouring New Brunswick and along the entire Maine coast. Prior to this sardine fishery, the small herring or sardines were used only for oil and fertilizer, and the larger herring were smoked. To-day the sardine-canning industry purchases the great bulk of the herring taken in the United States and southern New Brunswick. The other development was the expansion and intensification of lobster fishing in both countries after the 1860's (Found, 1912). This fishery has been carried on with great vigor, and large quantities of herring are used as bait, particularly in eastern Maine and the Canadian Maritime Provinces.

QUANTITIES LANDED

Although the herring fishery of eastern North America is more than four centuries old, comprehensive information on the total landings of herring in the eastern United States and Canada is available for only a relatively short period of time. Prior to World War I, the fishery statistics were not collected regularly. After the war, there was a great improvement in the frequency and coverage of the statistical surveys; consequently, the years from 1920 to 1954 have been selected to show the magnitude and trends of the herring fisheries.

From 1867, the time of Confederation in Canada to the end of 1910, Canadian fisheries statistics were collected on an annual basis by fisheries field personnel (officers of the Fisheries Branch of the Department of Marine and Fisheries). The statistics collected were not as extensive as those collected today, and dealt mainly with the quantity and value of the yearly catch, the quantity and value of fish exports, and a few other yearly series. Except for statistics of fish exports, which had a basis in recorded transactions, the system of statistical collection was quite elementary, and the estimates of fish landings were likely of dubious authenticity for some or many sections of the Maritime Provinces.

In 1911, the collection of statistics of fish landings on a monthly basis was introduced, and while the Fisheries Branch was transferred from the administration of the Department of Marine and Fisheries to that of the Naval Service for a period of six years (July, 1914-July, 1920), and a separate Department of Fisheries was formed in 1930, the procedures and methods employed in the collection of statistics underwent no major change until 1956. Improvements in the type of statistical forms employed and in the detail of statistics gathered did take place; but basically, the method of collecting data on fish catches remained the same—officers compiled their monthly statements of quantities of fish landed on the basis of estimates obtained from fishermen, fish buyers and fish processors.

While the method of collecting statistics during the period 1911-1956 remained substantially unchanged, the departmental reorganization of 1947 served to improve the quality of the primary statistics. This reorganization involved the setting up of Protection and Inspection Services within the Department, and the responsibility for the collection of statistics was placed upon the personnel of the Protection Service. This meant that a larger number of officers, whose work duties required more frequent visits to fishing ports, were charged with the collection of statistics, thereby facilitating and improving statistical field work.

In the southern New Brunswick region, where small herring are caught to be canned as sardines both in the United States and Canada, much reliance is placed on the purchase records of the Canadian canneries and on the export statistics of the Canadian Customs service. The statistics are submitted to the Department of Fisheries regional offices and are compiled annually by the Dominion Bureau of Statistics.

The United States was unable, because of limited appropriations, to establish complete and regular statistical coverage of its Atlantic coast fisheries before 1929. For the five-year period 1929 to 1933, the data are complete, but interruptions occurred thereafter. Information for the years 1934, 1936, 1941, 1943 and 1946 is not available, but after 1947 censuses have been completed for each year.

The United States has had various methods for collecting information on the herring catches. Up to 1939, statistical agents of the United States Bureau of Fisheries gathered the data on fish production, including herring, in the various states. These men travelled along the coasts and asked the fishermen the poundage and value of the fish caught and the types and quantities of

gear used in the preceding year. A complete canvass of the fishery industry of a state the size of Maine required about one-man-year of effort; consequently, annual production figures were usually available one or more years late.

Since 1939, the fishery statistical systems of the herring-producing states on the east coast of the United States have been gradually changing from a purely federal undertaking to either state or joint federal-state operations. The Maine Department of Sea and Shore Fisheries, under the guidance of the United States Bureau of Fisheries, began collecting monthly catch figures in 1939. These monthly canvasses were the sole responsibility of the state until 1946 when the United States Fish and Wildlife Service (successor to the Bureau of Fisheries) began to share the task. This cooperative endeavour has continued. Such joint arrangements have also been established between the Fish and Wildlife Service and the states of Rhode Island, New York and New Jersey. The state of Maryland collects monthly figures independently. Statistics from New Hampshire, Massachusetts, Connecticut, Delaware and Virginia are still the responsibility of the federal government, with state personnel assisting at times.

Maine is the most important herring-producing state, and considerable effort has been expended to improve its statistical system. When the Maine Department of Sea and Shore Fisheries began collecting monthly fisheries statistics, its wardens were given the responsibility for obtaining the information concerning herring landings. Each warden was expected to interview the fishermen in his district each month to learn how many pounds of herring had been caught. This system did not provide the daily catch records nor the exact localities of capture—both types of information that are valuable in understanding the movements and availability of herring.

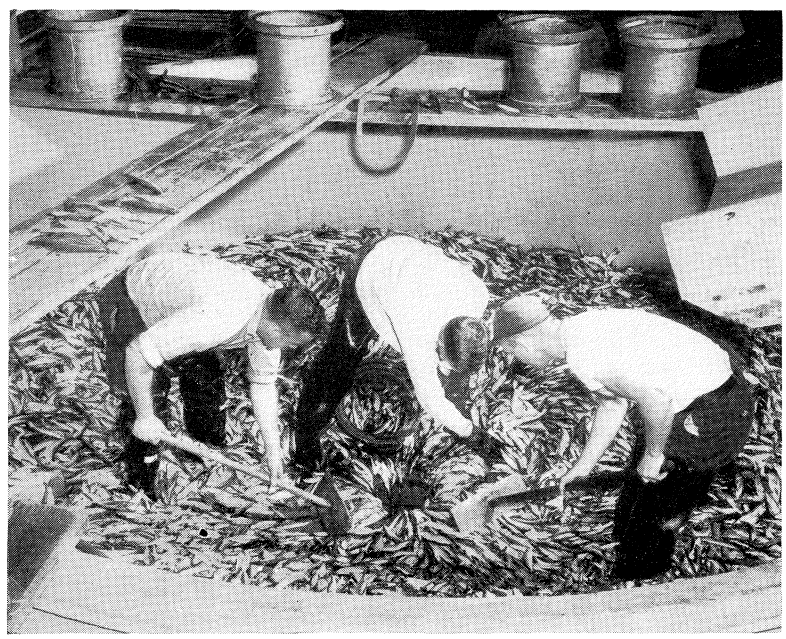


FIG. 5. State of Maine Inspectors examine load of sardines before delivery to the canneries. (Photograph by Richard Merrill.)

In 1947, the Maine Sardine Packers Association, the Maine Department of Sea and Shore Fisheries and the Fish and Wildlife Service began a cooperative herring investigation, under the direction of the federal agency. Improvement of herring catch records was an important part of the study (Scattergood, 1949; Scattergood and Trefethen, 1952). In 1947, scientific personnel of this investigation, with the assistance of the sardine cannery operators, were able

to obtain daily catch records of herring landed at the canneries. Each landing record had the fisherman's name, quantity of herring caught, date and locality of capture, and the name of the cannery. Similar data were collected from fish meal plants, herring smokers, herring picklers, and cat food canners. This system was a great improvement over the previous arrangement that depended entirely upon warden's reports. In 1948, the wardens were no longer charged with the responsibility for the herring statistics; instead, the herring investigation staff and the Maine statistical agents, both state and federal, obtained the data directly from the purchasers, as in 1947.

In 1949 a further change occurred. The Maine Department of Agriculture agreed to have its Division of Inspection personnel, stationed at each sardine cannery, provide the necessary landing information on Keysort cards. The inspectors forward the cards to their central office where they are examined by the statistical agents of the Fish and Wildlife Service and the Maine Department of Sea and Shore Fisheries. These agents use the information in their monthly Maine fish landing reports. The cards are then given to the scientific personnel of the Fish and Wildlife Service's Atlantic Herring Investigations.

Table I shows the landings of herring in the Northwest Atlantic region between 1920 and 1954. The United States production is shown by states from Virginia to Maine. Canada's landings are divided into five principal regions rather than by provinces. The Bay of Fundy region includes parts of both New Brunswick and Nova Scotia, and has a shoreline from the international boundary in southern New Brunswick to Digby County, Nova Scotia. The Atlantic coast area extends from Yarmouth County to Victoria County, all in Nova Scotia. The Southern Gulf region extends from Inverness County, Nova Scotia, to Restigouche County, New Brunswick, and includes the Magdalen Islands and Prince Edward Island. The Northern Gulf area includes the Gaspé peninsula, Anticosti, and the north shore of the Gulf of St. Lawrence from Orleans Island to the Strait of Belle Isle. The Newfoundland and Labrador region includes the waters around those two geographical areas.

The fisheries of two adjacent regions, the state of Maine and the Canadian Bay of Fundy, produce almost half of the total herring landed from Northwest Atlantic waters. Herring production in the other parts of the eastern United States is of minor importance; the remaining Canadian Atlantic regions, however are large producers. The average yearly Atlantic herring catches during the periods for which we have records are 43,916 metric tons[1] for the United States and 98,344 metric tons for Canada. The maximum yield in the United States was 89,142 tons in 1950, and in Canada 187,633 tons in 1946. The 242,311-ton total catch in 1948 is the maximum for the two countries together.

Figure 6 shows the landings as compiled in Table I and includes totals for the years 1924, 1928, 1941, 1943 and 1946. Some of the landings were not reported (Table I) for these years but are likely to affect the overall totals only very slightly. The yearly Canadian herring catches began rising with the beginning of the Second World War in 1939 and then decreased after 1946. The post-war catches, however, have not declined to the level of the pre-war production. In comparison to those of Canada, the United States catches show much greater fluctuations from year to year. Maine is the greatest producer of herring,

[1] 10,000 metric tons = 11,023 (short) tons = 22,046,000 lb.

TABLE I. Northwest Atlantic herring production by areas, in metric tons, for the period 1920–*Fishery Statistics of the United States*, and *Fisheries Statistics of Canada*. Years in which no suses were made in all states.

Year	United States										
	Virginia	Maryland	Delaware	New Jersey	New York	Connecticut	Rhode Island	Massachusetts	New Hampshire	Maine	Total
1920	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
1921	0	0	0	78	3	.....	.....	.....	.....	.....	.....
1922	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
1923	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
1924	.....	.....	.....	.....	.....	<1	230	4,098	0	21,741	.....
1925	0	0	.....	.....	.....	<1	.....	.....	.....	.....	.....
1926	.....	.....	0	107	1	<1	.....	.....	.....	.....	.....
1927	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
1928	.....	.....	.....	.....	.....	1	100	2,561	0	29,341	.....
1929	0	0	0	19	7	0	1,072	5,896	0	41,668	48,662
1930	0	0	0	299	15	0	97	3,940	27	33,548	37,916
1931	0	0	<1	181	21	0	107	3,574	4	25,304	29,191
1932	0	0	7	279	11	0	181	2,580	0	14,510	17,568
1933	0	0	0	268	34	0	334	1,621	<1	19,856	22,113
1934	164	0	.....	.....	.....	.....	.....	.....	.....	.....	.....
1935	<1	0	0	117	34	0	89	1,447	0	23,107	24,794
1936	210	0	.....	.....	.....	.....	.....	.....	.....	.....	.....
1937	0	0	0	166	2	0	89	1,313	0	22,658	24,228
1938	0	0	0	527	7	0	50	2,214	0	7,283	10,081
1939	2	0	0	565	19	<1	20	2,513	0	31,572	34,691
1940	3	0	0	857	16	<1	61	2,676	0	17,244	20,857
1941	<1	0	.....	.....	.....	.....	.....	.....	.....	32,931[a]	.....
1942	2	0	0	888	<1	0	15	2,561	0	42,637	46,103
1943	.....	.....	0	992	66	2	11	1,329	0	25,941	.....
1944	31	14[b]	0	647	18	2	14	598	0	37,243	38,567
1945	53	79[b]	<1	712	15	2	14	705	0	41,999	43,579
1946	13	18[b]	.....	.....	285	47	65	929	0	36,336	.....
1947	63	19[b]	9	2,445	63	93	83	1,084	0	55,029	58,888
1948	95	29[b]	9	752	10	1,498	556	2,315	0	82,764	88,028
1949	37	16[b]	0	890	100	1,211	1,930	5,259	0	67,991	77,434
1950	45	15[b]	0	498	63	351	375	3,661	0	84,134	89,142
1951	36	1[b]	0	758	246	641	402	1,305	0	27,097	30,486
1952	8	2[b]	0	716	25	1,233	1,184	1,598	0	65,618	70,384
1953	<1	<1[b]	<1	307	14	1,499	984	2,032	0	45,626	50,464
1954	2	<1[b]	<1	294	145	768	477	1,303	0	65,065	59,056
Average	28	7	1	557	49	272	342	2,364	1	38,047	43,916

[a]From *Maine Department of Sea and Shore Fisheries* and *Fish and Wildlife Service* monthly reports.

[b]From *Maryland Commercial Fisheries Statistics*, Publications No. 69 and 94, with supplements for 1951, 1952, and 1953.

1954. Except where noted otherwise, data are from *Fishery Industries of the United States*, census was taken are marked by dots. Figures in the Total columns are for years in which cen-

Canada						United States and Canada Grand Total	Year
Bay of Fundy	Atlantic Coast	Southern Gulf	Northern Gulf	Newfoundland and Labrador [c]	Total		
29,438	7,920	20,221	2,753	27,480	87,812	.....	1920
19,791	5,853	13,634	3,773	24,578	67,629	.....	1921
30,516	5,392	19,036	2,449	24,256	81,649	.....	1922
15,684	3,539	19,522	5,066	19,870	63,681	.....	1923
33,048	7,054	18,760	3,957	16,998	79,817	.....	1924
24,488	5,347	20,749	6,008	16,707	73,299	.....	1925
28,993	6,768	19,780	9,069	18,422	83,032	.....	1926
25,070	6,824	19,759	6,913	18,789	77,355	.....	1927
35,211	4,278	16,354	6,748	18,962	81,553	.....	1928
33,440	8,322	19,752	4,320	16,577	82,411	131,073	1929
21,783	7,060	20,102	4,037	13,315	66,297	104,213	1930
17,025	6,389	19,050	5,910	13,238	61,612	90,803	1931
13,637	5,455	17,748	6,998	11,888	55,726	73,294	1932
19,621	7,300	22,372	5,893	10,462	65,648	87,761	1933
28,155	7,164	18,665	11,146	9,339	74,469	.....	1934
27,636	8,391	19,653	7,908	12,825	76,413	101,207	1935
33,219	8,101	23,694	11,337	11,956	88,307	.....	1936
23,907	7,355	20,331	12,143	11,855	75,591	99,819	1937
23,592	9,164	23,089	13,402	13,187	82,434	92,515	1938
39,218	9,079	21,547	10,925	22,609	103,378	138,069	1939
31,861	9,351	22,254	13,834	18,414	95,714	116,571	1940
48,719	9,696	19,441	9,608	14,956	102,420	.....	1941
40,690	13,186	20,200	12,391	23,623	110,090	156,193	1942
46,799	14,454	25,408	11,494	32,154	130,309	.....	1943
46,583	18,843	22,011	9,812	38,591	135,840	174,407	1944
39,383	20,225	19,480	9,812	60,205	149,105	192,684	1945
57,313	20,423	26,656	8,985	74,300	187,677	.....	1946
54,151	18,636	29,497	6,310	46,106	154,700	213,588	1947
48,439	13,703	34,073	6,320	51,692	154,227	242,255	1948
34,377	16,765	26,595	6,510	27,553	111,800	189,234	1949
46,695	16,286	34,880	6,783	25,827	130,471	219,613	1950
38,118	13,198	37,615	5,485	27,056	121,472	151,958	1951
45,274	17,125	40,164	5,907	24,391	132,861	203,245	1952
29,538	15,423	32,541	7,473	17,091	102,066	152,530	1953
33,636	13,080	31,611	5,985	23,095	107,407	166,463	1954
33,287	10,490	23,321	7,642	23,953	98,693	147,500	Average

[c]From *Markets and Economics Service*, Department of Fisheries (Newfoundland and Labrador).

74860-8—4

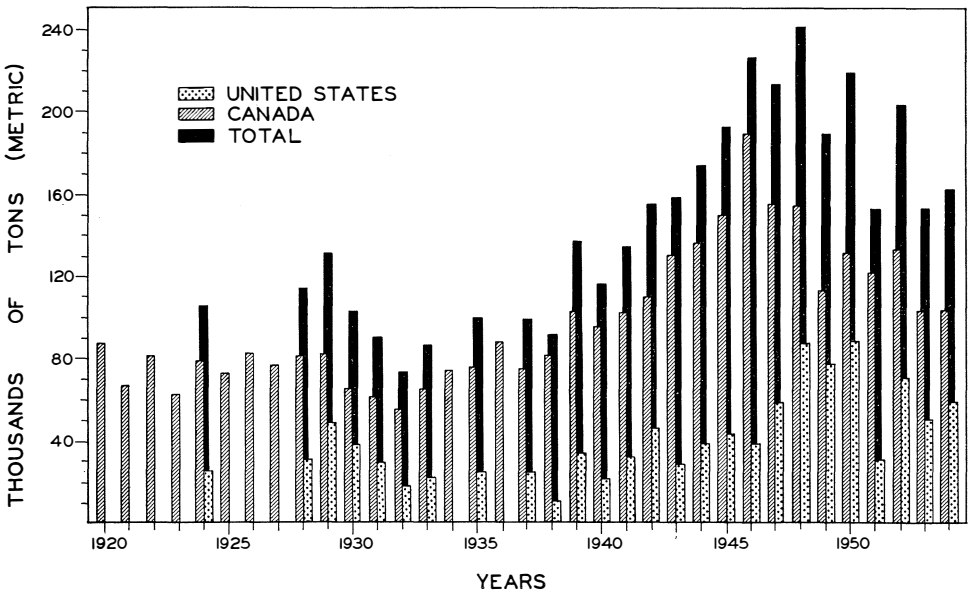


FIG. 6. Annual landings of herring in the northwest Atlantic, 1920–1954.

and the fluctuations in the United States catch are caused primarily by the varying catches in that state. Following an extremely low yield of herring in 1938, the yearly United States catches increased to a level generally above that of the 1920's and 1930's. Considering both the Canadian and United States catches during recent years, it is evident that the yield of the fishery during the present period beginning in the 1940's is much greater than in the preceding two decades.

The yearly catches are influenced by both economic and biological factors. Consequently, as comparative measures of the abundance or availability of the fish, the yearly catch figures must be used with considerable caution and only with some knowledge of the conditions that may affect the production.

The economic factor is an important influence on the size of the yearly catches. In many years, the landings reflect the size of the demand for herring to be used as bait or for herring products, which include pickled herring, smoked herring, fish meal, and canned items such as sardines, kippers, cat food, and herring in mustard or tomato sauces. The amounts of herring landed are also dependent to a great extent on the prices paid to the fishermen for herring, and these prices fluctuate with the domestic and imported supplies available to the distributors. Competition with processed herring or sardines imported from European countries affects the landings; in the face of this competition, it has sometimes been difficult for Canadian or United States processors to pay enough for raw herring to stimulate fishermen to catch these fish. For example, prior to the period in the 1940's when the pilchard fishery of western North America collapsed, California pilchards offered strong competition in both the domestic

and foreign sardine markets and thus influenced, in Maine and New Brunswick, the size of the sardine pack, the price of raw sardines and the quantity of herring landed.

Biological factors affect catches by influencing the abundance and availability of the herring. Poor survival of the young herring is reflected in small year classes of sardines, and the landings often decline accordingly. A succession of poor year classes means that recruitment to the large, mature populations will be below normal, and this in turn can affect the catches of adult fish. The disease organism *Ichthyosporidium hoferi* also appears to be a factor that governs the size of the herring populations in parts of the Gulf of St. Lawrence (Sindermann, in press). While the influence of hydrographic conditions on the availability of the northwest Atlantic herring has not yet been clearly demonstrated, we feel that the varying seasonal and geographic occurrences of this species may depend upon prevailing oceanography. As a possible result, herring may, in some years, fail to appear at the usual time in the waters of a particular region. Since the fishery operates in rather localized, inshore waters and there is little exploration to discover offshore schools, it may be possible for landings to decline although the herring populations are relatively unchanged.

The period 1941 to 1947 is a rather exceptional one, for it represents a time when the demand for herring was practically unlimited, because of Canadian and United States Government orders for large quantities of herring, both salted and canned. However, the catches of herring during those seven years must not be considered as the maximum yields possible, because the processors and fishermen were both handicapped by war and post-war conditions. In some instances, the labor supply at the canneries or salting establishments was insufficient to handle the catches, and fishing had to be restricted. This problem is not now so acute in the sardines-producing areas, for there is an increased number of fish meal plants that can utilize much greater quantities of herring than was previously possible.

74860 -8—4½

SEASONAL NATURE OF THE FISHERY

Herring fluctuate greatly in availability from season to season and year to year. In most parts of their range the herring usually appear regularly and, if a suitable market exists, the fishermen are ready to harvest them when they arrive. Occasionally, however, because of changes in their habits or migratory patterns, these fish may not be available on the customary grounds, and the local fishery for them may be a failure.

In general, south of Cape Cod, Massachusetts, landings are made during December to May, while in the Gulf of Maine and the Bay of Fundy, the fishery is most active during May to November, when one- and two-year-old fish are taken for canning as sardines. Along the Atlantic coast of Nova Scotia, the fishery is most productive in July to September. In the Gulf of St. Lawrence, the April and May fisheries predominate, while at Newfoundland the greatest catches are made in the winter and spring. Except for the Maine and Bay of Fundy fisheries, most of the herring caught are large and mature.

Table II shows the average monthly herring catches for five states and ten Canadian areas during 1945-1954. The monthly distribution of the catches for Maine and the Canadian regions is based on data published monthly during the entire period; for the other four states, the average monthly production is calculated from the total yearly catches during the 10-year period and from the monthly landings obtained over a briefer period. Information from this table is illustrated in Fig. 7-9.

TABLE II. Monthly herring landings, in metric tons.
Average for the period 1945–1954[a]

UNITED STATES

Month	New Jersey[b]	New York[c]	Rhode Island[d]	Connecticut[d]	Massachusetts[e]	Maine[f]	Total
January	141	1	197	239	1	1	578
February	20	3	255	308	1	190	776
March	122	2	44	53	2	303	526
April	370	54	58	70	160	17	729
May	53	34	20	24	525	2,226	2,882
June	3	1	4	5	85	8,596	8,693
July	3	—	1	1	50	10,144	10,197
August	—	—	1	1	123	10,242	10,365
September	1	1	1	1	440	7,395	7,837
October	1	—	4	5	182	10,067	10,258
November	8	2	11	13	339	5,348	5,721
December	99	1	13	16	113	804	1,046
Average Yearly Catch	819	97	607	734	2,019	55,332	59,608

See footnotes, page 15

TABLE II. *(Concluded)*

CANADA[g]

Month	N.B. Bay of Fundy	N.S. Bay of Fundy	N.S. Atlantic Coast	N.S. Gulf	P.E.I.	Magdalen Is.	N.B. Gulf
January	960	5	—	—	—	—	—
February	1,069	11	—	—	—	—	—
March	1,479	89	10	—	—	—	—
April	1,016	37	385	53	230	3,083	853
May	1,540	234	867	200	1,960	6,133	15,202
June	2,740	940	865	76	90	411	275
July	6,143	1,404	4,173	14	6	22	18
August	8,937	997	5,050	25	29	6	1,060
September	7,519	355	3,419	64	94	3	579
October	4,581	155	750	14	14	—	22
November	2,147	62	243	2	3	—	<1
December	699	4	7	—	1	—	—
Average Yearly Catch	38,830	4,293	15,769	448	2,427	9,658	18,009

CANADA

Month	Gaspé P.Q.	North Shore P.Q.	Nfld. and Labrador[h]	Canada Total	Canada and United State Total
January	—	—	1,680	2,645	3,223
February	—	—	318	1,398	2,174
March	—	—	823	2,401	2,927
April	104	1	3,392	9,154	9,883
May	3,552	32	3,271	32,991	35,873
June	906	49	584	6,936	15,629
July	900	13	86	12,779	22,976
August	722	35	98	16,959	27,324
September	546	65	146	12,790	20,627
October	235	18	215	6,004	16,262
November	83	<1	2,789	5,329	11,050
December	—	—	1,562	2,273	3,319
Average Yearly Catch	7,048	213	14,964	111,659	171,267

[a]The average yearly catch is from *Fishery Statistics* of the *United States* for the years 1945–1954.

[b]Monthly distribution is based on 1952–1956 *New Jersey Landings*.

[c]Monthly distribution is based on 1954–1956 *New York Landings*.

[d]Monthly distribution is based on 1954–1956 *Rhode Island Landings*.

[e]Monthly distribution is based on 1947–1955 *Massachusetts Landings*.

[f]Monthly distribution is based on 1945–1954 *Maine Landings*.

[g]Monthly figures are from FSI reports of Canadian Department of Fisheries, except for Newfoundland and Labrador.

[h]Monthly distribution is based on Canadian Department of Fisheries' Markets and Economics Service reports for year 1953–1956.

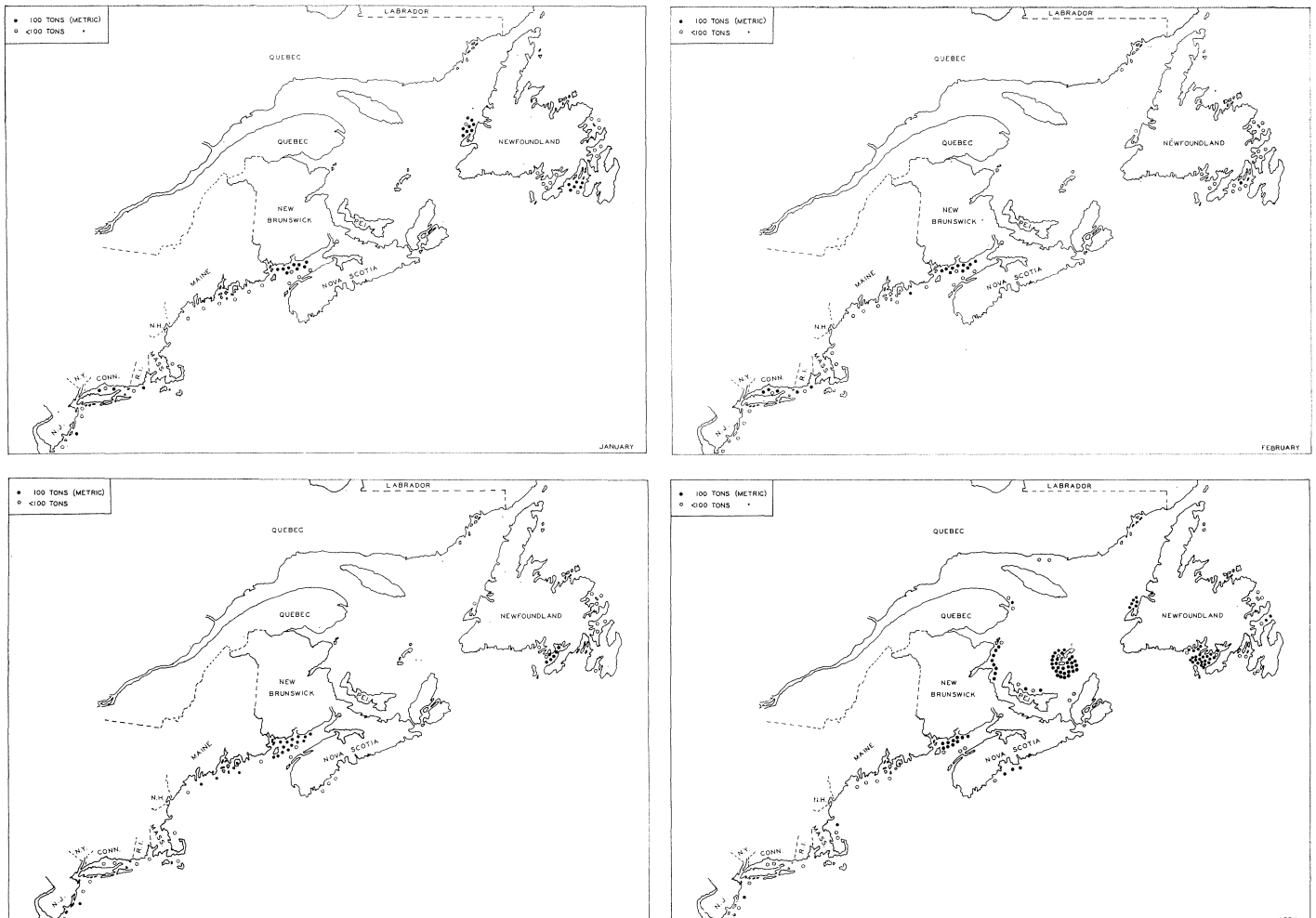


FIG. 7. Distribution of herring landings by month. 10 year average, 1944–1953 (January-April).

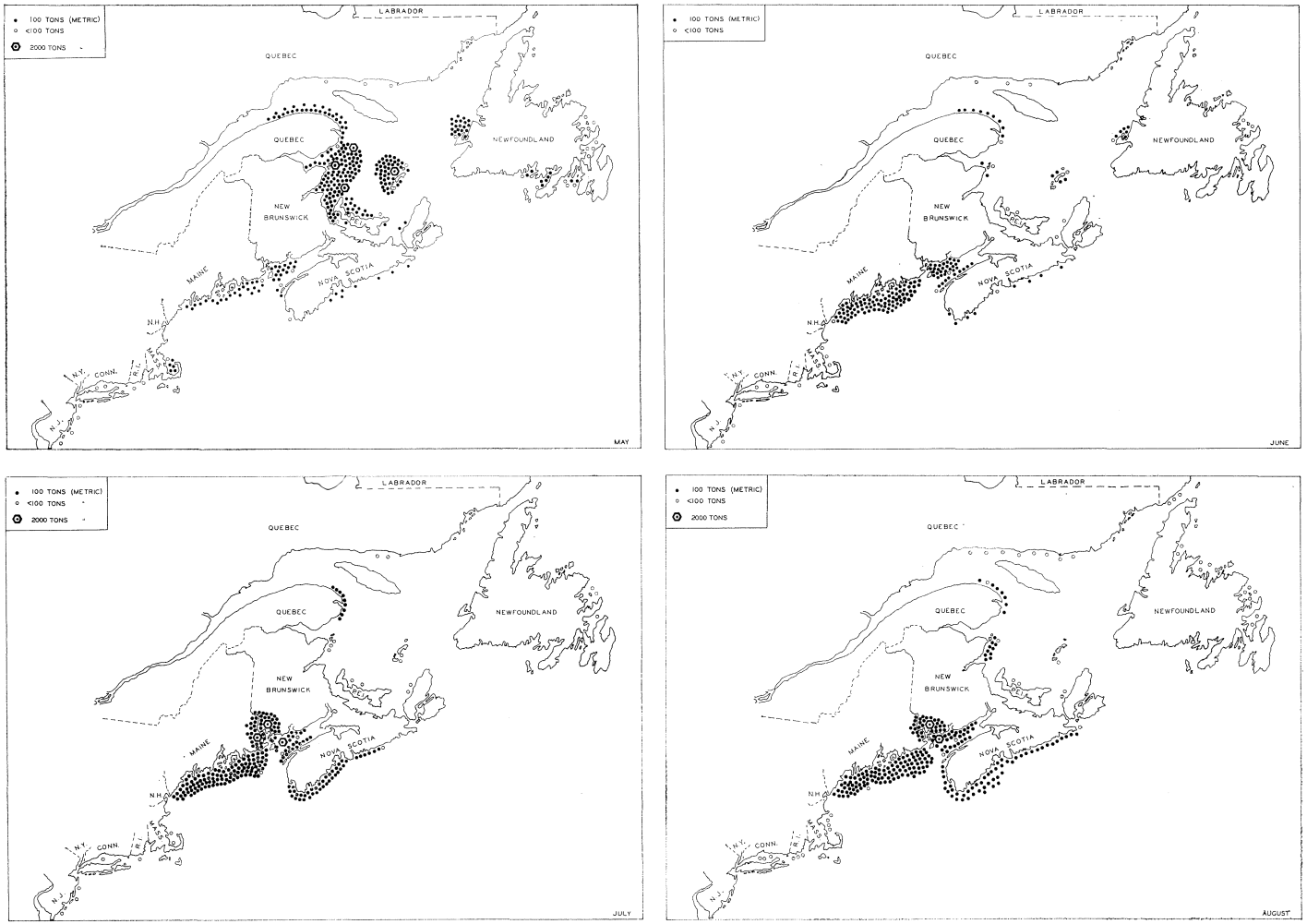


FIG. 8. Distribution of herring landings by month. 10 year average, 1944–1953 (May-August).

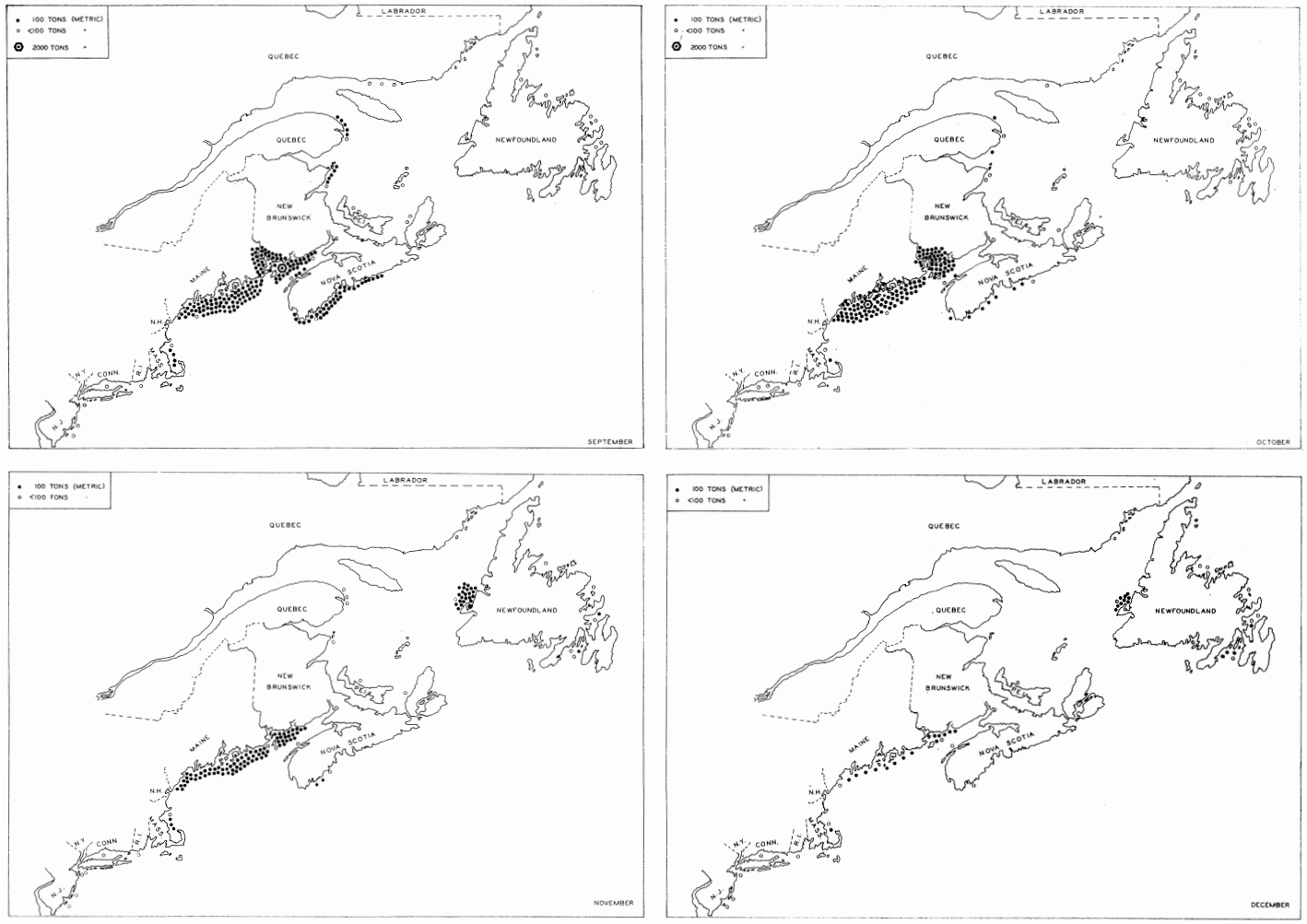


FIG. 9. Distribution of herring landings by month. 10 year average, 1944–1953 (September-December).

Herring are taken in the states south and west of Massachusetts during the colder parts of the year. Most of New Jersey's herring are caught during December to May; New York's catch is in April and May; and Rhode Island and Connecticut fishermen capture most of their herring in December to April. New Jersey has a pound net fishery throughout the year, so that her catches reflect to some extent the availability of herring along her inshore areas during the year. New York has had pound nets in action only for short periods in December and usually none in the winter and early spring until April. In Rhode Island and Connecticut, otter trawl fleets of small boats operate throughout the year, and pound nets are fished between April and November. Consequently, we may assume that limited quantities of herring are taken south of Massachusetts during the months of June through November because there are few of this species in the coastal areas.

In Massachusetts, herring are seldom caught during the period January to March. When pound nets begin to operate in April and May, the catches increase. In the summer, the herring landings diminish and, in the autumn, increase again. Often throughout the summer and, particularly in the autumn, sardine herring are taken by torching. Otter trawlers, principally on Stellwagen (Middle) Bank, often land large herring during August to October, and Massachusetts purse seiners, operating off the New Hampshire coast, land mature herring between September and December. In Massachusetts, there is no organized fishery for the small herring that may be abundant in the summer. Several times in the past, sardine canneries have been established there, but the supply of young herring was not dependable, and the operations were abandoned after a few years. We may assume that great numbers of sardine-sized herring do not occur regularly for any long period of time in the waters of that state.

In Maine, the fishery seldom takes herring in January, but is sometimes active during the rest of the year. During the period 1945-1954, there were several years when Maine's closed season for sardine-canning was relaxed to enable the canneries to pack as many fish as possible. In those years, herring were caught in February, March and April. Under the present law, herring can be canned only between April 15 and December 1. Because most of the Maine herring are used for sardines, this law has a definite effect on the seasonal distribution of the catches. The appearance of large numbers of sardines along the Maine coast between December and April is not customary, however, so that the legal season restrictions in most cases do not influence markedly the seasonal availability of the fish as indicated by the monthly landings. As shown in Table II and Fig. 7-9, the Maine fishery for herring is principally a late spring to late autumn operation.

In Canada, the herring fishery is carried on throughout the entire year, but not in all areas (Table II, Fig. 7-9). In the Bay of Fundy region, the catch is composed almost entirely of juvenile herring, and approximately one-third of the total Canadian Atlantic catch is made on the western side of the Bay in Charlotte and Saint John Counties. The fishery in this area is most productive

from July to October, and 70% of the landings are made during these four months. There is a late summer-spawning stock that is exploited in the Grand Manan area, but apart from this the fishery is almost entirely for one- and two-year-old herring. Brush weirs yield most of the catches during the period from May to October; purse seining, stop or shut-off seining, and beach seining operations are responsible for the majority of landings during the remainder of the year. Availability of the fish, weather conditions, and market demand are the most important factors in the seasonal distribution of catches; recruitment of a new year-class during the late summer and autumn undoubtedly contributes to increased landings then. In contrast to the situation in the neighbouring state of Maine, there are no seasonal restrictions in the processing of herring in New Brunswick, and canneries remain open throughout the year when adequate supplies of raw materials are available. Lack of a regular supply of herring, however, will force some canneries to close, and thus the activities of the winter purse seine fishermen will be restricted.

FIG. 10. Sardine carriers at Black's Harbour, N.B. (Photograph by National Film Board of Canada, courtesy Connor's Bros. Limited, Black's Harbour, N.B.)

On the Nova Scotia side of the Bay of Fundy, the herring fishery is very similar to that in southern New Brunswick, except that the landings are much smaller. The fishery is chiefly in Digby County, with catches becoming progressively smaller towards the head of the Bay. Approximately 86% of the catches are made from June to September inclusive (Table II), and fishing methods are the same as in Charlotte and Saint John Counties. It is difficult

to determine whether landings reflect abundance in this area. The principal markets are in New Brunswick and Maine where raw Digby County herring can be sold only if the fish are scarce in areas closer to the canneries and reduction plants.

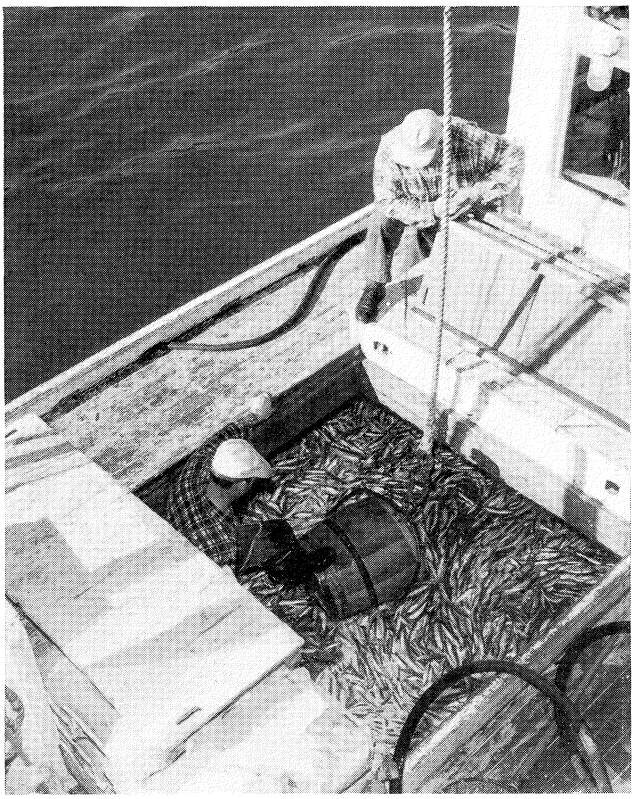


FIG. 11. Unloading sardines at a Canadian cannery. (Photograph by P. W. G. McMullon, courtesy Connor's Bros. Limited, Black's Harbour, N.B.)

On the Atlantic coast of Nova Scotia, the herring fishery is most productive in the summer and early fall months. It is based on aggregations of prespawning and spawning stocks that are taken chiefly with anchored gill nets close to the shore (Tibbo, 1957b). During the 1920's there was some drift netting and purse seining for herring in the spring, particularly along the western part of Nova Scotia, but such activities are rare now.

The major herring fisheries in the Gulf of St. Lawrence are carried on during a spawning migration in April and May. There is also an autumn-spawning stock in Gaspé and Chaleur Bay that supports small scale gill net fisheries in those areas, and some catches of immature fat herring are made with drift gill nets throughout the summer months. Sardine-sized herring are taken during the spring with weirs near the entrance to the Saguenay River at Ile Verte (Day, 1957a).

The Newfoundland herring fishery is centred chiefly in Bay of Islands on the west coast, and Fortune Bay on the south coast. Some herring are taken during every month of the year, but for any one area, the fishery is seasonal and in most cases, occurs near the spawning time. It is, however, essentially a winter and spring fishery (Tibbo, 1957c). Herring are available inshore during the late autumn and remain until they spawn the following spring. In Placentia Bay and along the east coast, there are small fisheries that are most active during the spring-spawning season. Prior to 1920, there was a large herring fishery on the east coast of Newfoundland and centered in Notre Dame Bay. This fishery was abandoned because of poor market conditions at that time and has not been revived to any great extent.

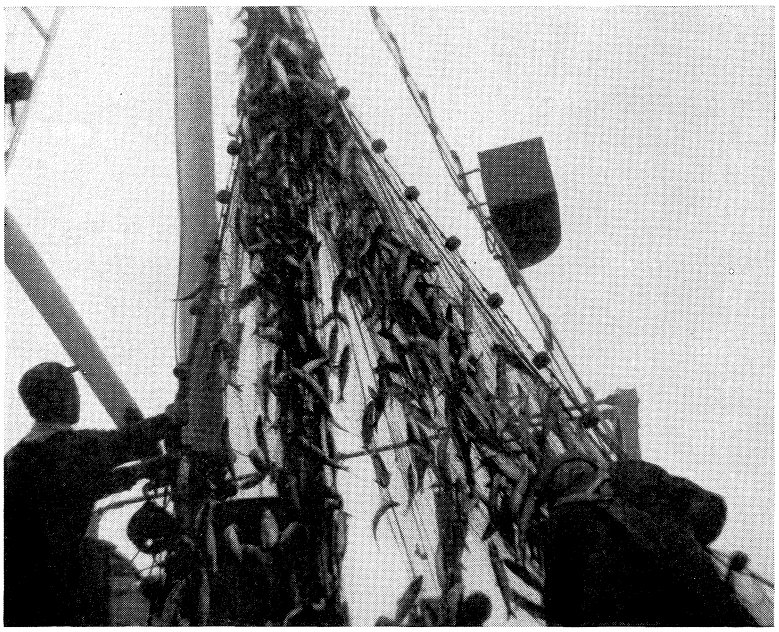


FIG. 12. Loading a large drift-net catch in the Gulf of St. Lawrence. (Photograph by E. G. Sollows.)

In Labrador, herring occur at various points along the coast between the Straits of Belle Isle and Cape Harrison. Most of the fish are caught during the summer, after their spring-spawning. They are taken close to the shore with floating traps and anchored gill nets, chiefly by vessels engaged in the cod fisheries of that area. The fishery is erratic and has at no time been very extensive. Attempts to develop a herring meal and oil industry during the early 1940's failed because of irregular supplies of fish. Seasons are characterized either by great abundance of herring or by complete failure of the fish to appear on the coast.

FISHING GEAR

In the seventeenth century, when the early colonists arrived in eastern North America, several types of herring fishing gear were being widely used in Europe. Gill nets, seines, and weirs had been in use there for centuries before the settlement of Canada and the United States, and although other types of gear have since evolved, these old apparatuses are still important for capturing herring. Table III shows the United States Atlantic catch by gear and states for the period 1945-1954. It is apparent that the stop seine, weir and purse seine account for over 93% of the total catch. Comparable data are not available for Canada, but our observations indicate that weirs are the most important gear for the sardine-sized fish in southern New Brunswick. Elsewhere in Canada the gill net dominates, with relatively minor quantities of herring being caught by floating traps and by purse seine.

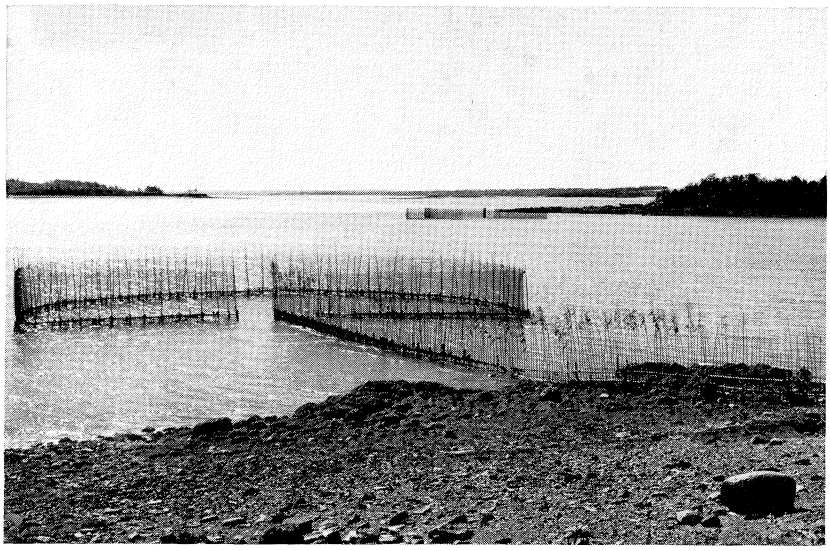


FIG. 13. A typical Charlotte County weir at low tide. (Photograph by P. W. G. McMullon.)

GILL NETS

The herring gill net, while now seldom used in the United States, is still one of the principal gears for herring fishing in eastern Canada. The usual net is about 35 fathoms long, 4 to 6 fathoms deep, with a stretched mesh size of $2\frac{1}{2}$ to $2\frac{3}{4}$ inches. In some areas, where the herring are generally small, the mesh size may be only $1\frac{1}{2}$ inches; in regions with large herring, the mesh size may be increased to 3 inches. Cotton is the predominant material; nylon and linen are seldom used at the present time. In Canada, the nets are usually fished

TABLE III. United States catch of herring by gear, in metric tons, for 1945–1954. Data are from *Fishery Statistics of the United States*, 1945–1954, except for Maryland for which were used 1951, 1952 and 1953 *Maryland Commercial Fisheries Statistics*, Publication No. 69 and 94, with supplements for 1951, 1952 and 1953.

Gear	Virginia	Maryland	Delaware	New Jersey	New York	Connecticut	Rhode Island	Massachusetts	Maine	Total	Percentage
Stop seine	.....	.....	.....	.....	.....	.....	.....	.....	270,115	270,115	44.6
Weir	.....	.....	.....	.....	.....	.....	.....	.....	191,214	191,214	31.6
Purse seine	.....	.....	.....	3	.....	.....	.....	2,238	99,426	101,667	16.8
Pound net[a]	153	117	.....	6,970	1	1	902	7,035	1,905	17,872	3.0
Otter trawl	173	63	19	297	7,341	7,341	4,967	3,785	.....	16,813	2.8
Dip net[b]	.....	.....	.....	.....	.....	.....	.....	7,106	.....	7,106	1.2
Haul seine	.....	.....	.....	23	.....	.....	200	.....	.....	230	0.04
Gill net[c]	30	1	1	69	.....	.....	.....	28	1	131	0.02
Fyke net	.....	.....	.....	10	.....	.....	.....	.....	.....	10	0.01
Total	356	180	20	7,372	966	7,342	6,069	20,192	562,660	605,158	100.0

[a]Includes floating traps.

[b]Gear used in torching.

[c]Includes drift gill nets, stake gill nets, anchor gill nets, and run-around gill nets.

singly, although occasionally two or three nets may be joined. Small boat fishermen carry on this fishery for a period of only a few weeks, and the gear is set where the mature herring are known to occur during that season. Since so few nets are used per boat, practically all the hauling is done by hand rather than by power. Most of the nets are anchored; few are used as drift nets. Perley (1850) early advocated the use of drift rather than anchored gill nets in the Gulf of St. Lawrence, for he believed that a deep-sea herring fishery was possible; however, drift netting has never been popular. Herring gill netting in North America is in strong contrast with that of Europe where long strings of gill nets are set and hauled by power from large boats equipped with sonic or ultrasonic depth sounders that help locate the fish. In Europe, the herring are actively sought over wide areas of the ocean, while in North America, the gill netter's range is limited to local, inshore regions.

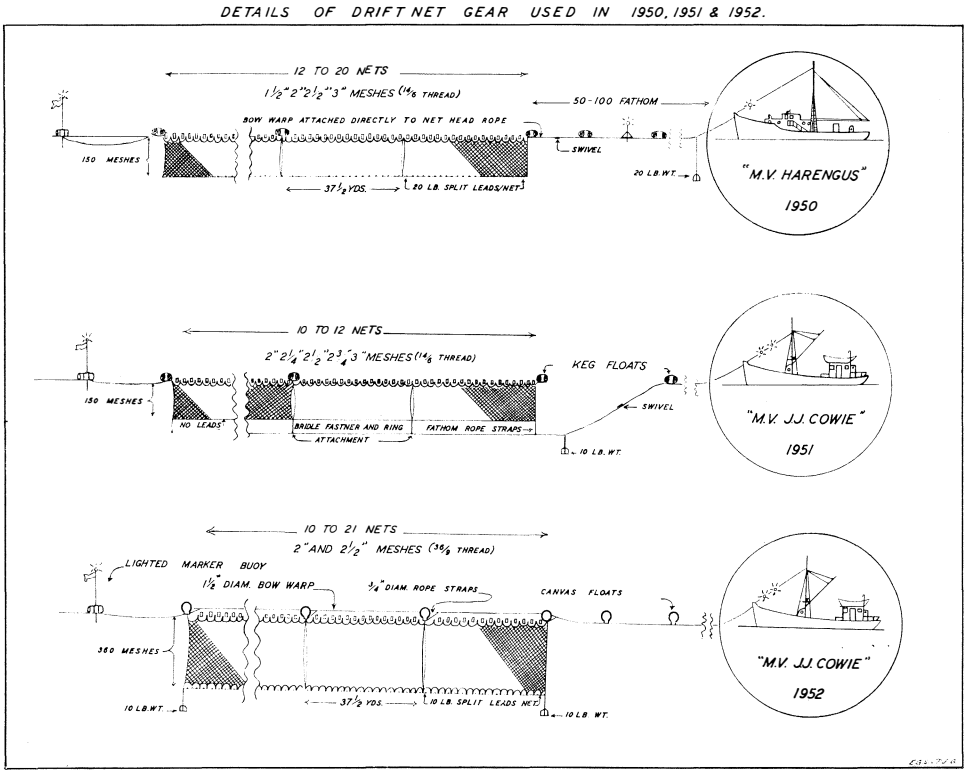


FIG. 14. Details of experimental drift-net gear used in the Gulf of St. Lawrence. (From Tibbo and Sollows, 1953.)

SEINES

Seines can be classified into two principal types; stop seines and purse seines. The one known to the colonists was the stop seine, beach seine, or drag seine. This gear is widely used for herring that visit relatively shallow water

areas. According to Earll and Smith (1889), these seines had widespread use in most areas of the Maritime Provinces prior to 1880, but were first commonly used for small herring in the Passamaquoddy region in 1884. The lengths and depths of the nets now used vary considerably. The stop seine commonly used on the Maine and southern New Brunswick coasts for immature herring is about 80 to 100 fathoms long, 6 fathoms deep, and has a stretched mesh size of $\frac{3}{4}$ to 1 inch. Several nets may be tied together, when the area to be enclosed is large. Stop seining is generally a night operation, for schools of herring are often easily detected at that time by the "firing" of the water, caused by the school's disturbing the phosphorescent marine animals. During the daytime, when the schools are not visible beneath the surface, another detection method is occasionally used. A fine steel wire with a weighted end is dropped into the water and, from the number of vibrations that result when herring swim against the wire, the fisherman is able to make a rough estimate of the density of the school. Once a school is located in a cove or inlet, a stop seine is stretched from shore to shore across the entrance to bar the exit of the fish. The school is later condensed into a more compact mass and held until the herring have completely digested any food that may have been in their digestive tracts at the time of capture.

FIG. 15. A stop seine on the Maine coast. (Photograph by Richard Merrill.)

Searching for "firings" of the water is still the most widely used means of finding herring schools; however, several newer and alternative methods have been developed and adopted by stop seiners during the past several decades. Two new techniques now allow the stop seine fishery to operate at greater efficiency during daylight hours. One is the installation on the seine boats of

sonic or ultrasonic depth recorders; these devices came into common use after World War II. When the presence of a school of fish in a cove is indicated on the depth recorder, the seiner may set his nets and have some assurance of making a successful catch, even though there are no other signs of the herring. The other development is the use of airplanes to scout for herring schools during the daytime. Once herring have been located from the airplane, the pilot directs the stop seiners to the schools and often supervises the seining operations from the air. This aerial reconnaisance has been most successful in the central and western parts of the Maine coast where the shoreline is a maze of small inlets in which herring can be caught by stop seines and where the weirs are so few that seining is not restricted in many areas.

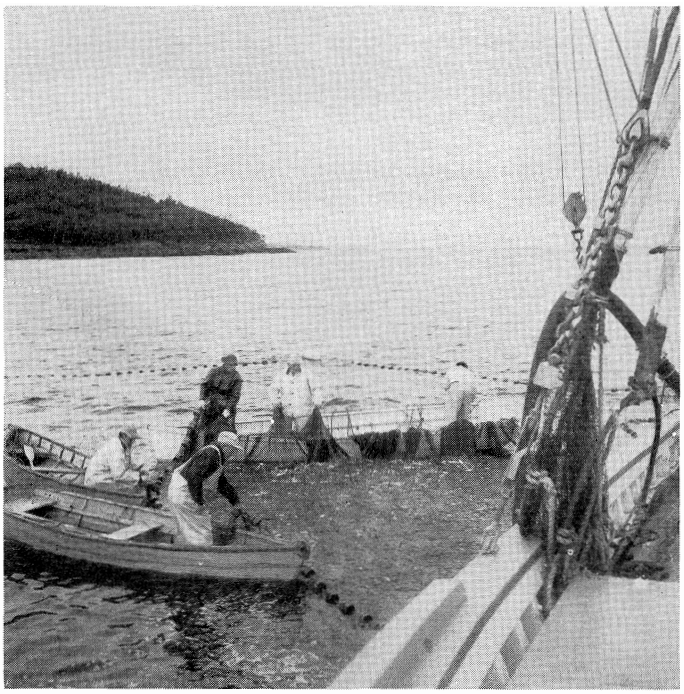


FIG. 16. Removing "sardines" from a Maine stop seine. Fish are pumped through the hose at the right of the photograph.

PURSE SEINE

The second type of seine is the purse seine, which differs from the stop seine in two ways: first, by having on the bottom of the net a series of purse rings through which a purse line is drawn to close the lower part of the net and, second, by being handled entirely from boats, with the ends of the net not attached to the shore. This gear, developed in the United States during the 1860's, accounts for a greater production of fish than any other apparatus in North America. In the herring fisheries of the eastern coasts of Canada and the United States, however, the purse seine has never been as important as the

gill net, stop seine, or weir. The herring purse seine used on the Atlantic Coast for mature fish is about 100 fathoms long, 15 fathoms deep, with $1\frac{1}{4}$- to $1\frac{1}{2}$-inch mesh; the purse seine for smaller, sardine-sized fish is usually about the same length and depth with $\frac{3}{4}$- to $1\frac{1}{8}$-inch mesh. The purse seiners that fish for large herring locate the schools during the night-time by the "firing" of the water or by depth recorders. Few large herring are caught during the day, for even though they may occasionally be seen schooling near the surface, they then seem to avoid the nets more readily than in darkness. Purse-seining in inshore areas for the smaller fish is often effective during the winter months in southern New Brunswick and occasionally in eastern Maine, for the fish seem to be rather lethargic in the cold, relatively shallow water, where they are detected by depth recorders. During the last two decades, on the west coast of Newfoundland, large Pacific coast type purse seiners (about 80 ft long), have become increasingly important in the herring fishery and account for the major part of the catch in the Bay of Islands area.

FIG. 17. A Pacific Coast purse seiner. Introduced to the Newfoundland area in 1939. (Photograph by National Film Board of Canada.)

BRUSH WEIRS

The brush weir is a stationary type of gear that is used by both primitive and civilized people throughout the world, and it is probable that it was known to the early colonists before they arrived in North America. If this gear were perchance not known to them previously, they were soon acquainted with the Indians' use of it, for the brush weir is a simple and efficient device for capturing anadromous fish such as alewives, salmon, shad, and smelts. It is believed that the first herring weirs built by white settlers were used in Nova Scotia in the latter part of the eighteenth century. In the 1820's, this gear was introduced into Maine and New Brunswick where it was quickly adopted by the

herring fishermen. Early weirs were simple structures of wooden stakes and brush erected in relatively shallow and protected waters; more complex and larger weirs in deeper water evolved later.

The principle of the herring weir is simple. It has two primary parts; a "leader" and a "pocket" (Fig. 13, 18). The leader is a fence-line barrier that directs the fish into the somewhat circular or heart-shaped pocket or pound from which they cannot easily escape. A weir may have more than one leader and often has a secondary pound into which lots of fish are diverted for storage from the primary pound.

FIG. 18. Seining a Maine weir.

POUND NETS

The pound net of southern New England and the middle Atlantic States is closely related to the weir. It operates on the same principle as the weir, for it has one or more leaders and a pound. Between the pound and the leader is usually a heart-shaped enclosure that deflects the fish into the pound. No brush is used in its construction; netting is suspended from the stakes or piles.

FLOATING TRAPS

The floating trap is somewhat similar to the pound net. It has a leader and a pocket, but it differs from both the weir and pound nets by having neither brush nor piles; it is made of netting entirely. In the water, the net is buoyed

by floats and is held in position with anchors. The floating trap has several advantages; first, it can be used in areas where piles cannot be driven into the bottom, and second, it can be moved with comparative ease. It is a common gear in Newfoundland, Labrador, and the Magdalen Islands; a few are fished in Maine and along other parts of the United States Atlantic coast.

Otter Trawling

Although one of the most important methods for capturing groundfish, such as redfish, haddock and cod, otter trawling is only of minor importance as a herring-fishing gear. The largest concentration of otter trawling for herring is in Block Island Sound where, since the end of World War II, 50- to 60-foot long Connecticut and Rhode Island boats catch herring during the winter months when they are often available. Larger Massachusetts otter trawlers also catch herring, principally during the summer and autumn months, but as a rule these vessels avoid areas where herring are readily caught. It is seldom profitable for these larger vessels to catch herring, which is a low-priced fish, when other more valuable fish are relatively plentiful, as they are during those months. Otter trawling is of very little importance in the Canadian herring fisheries.

Torching

One of the oldest methods of catching herring in eastern North America is night-time torching or driving (Earll, 1887; Sabine, 1853). The technique and necessary gear are simple (Fig. 2). From the bow of a small boat projects a light, which in early times was furnished by burning birch bark, then later by kerosene-soaked rags, and now also by electrically powered lamps or gasoline lanterns. As the boat moves through the water, herring are momentarily attracted to the light and are dipped up by a fisherman standing in the bow. The row boats of earlier years have now been replaced by gasoline-powered craft.

This fishing method was popular up to the latter part of the nineteenth century. It was an effective means of capturing immature herring during the winter months, and much of the winter catch in the Passamaquoddy Bay region of Maine and New Brunswick was taken by this gear (Earll and Smith, 1889). Large herring are not readily captured by this method (Allen *et al.*) 1837. It is interesting to note that at the beginning of the nineteenth century, torching was the exclusive method of herring fishing at Grand Manan Island in the Bay of Fundy (Donaldson *et al.*, 1837). The torchers were strongly opposed to the use of gill nets, which were introduced there in the 1820's, for they felt that netting was responsible for the decline in the herring catch in the 1830's. Torching later became illegal in many areas of Canada and the United States. Operators of other herring gear claimed, probably with little or no evidence, that torching dispersed the herring schools, and laws were passed to prohibit this practice. Although once a common means of catching herring in Massachusetts (Storer, 1839), large scale torching now survives only in Ipswich Bay and that is restricted by the lack of a demand for more than relatively small amounts of fish for fresh consumption.

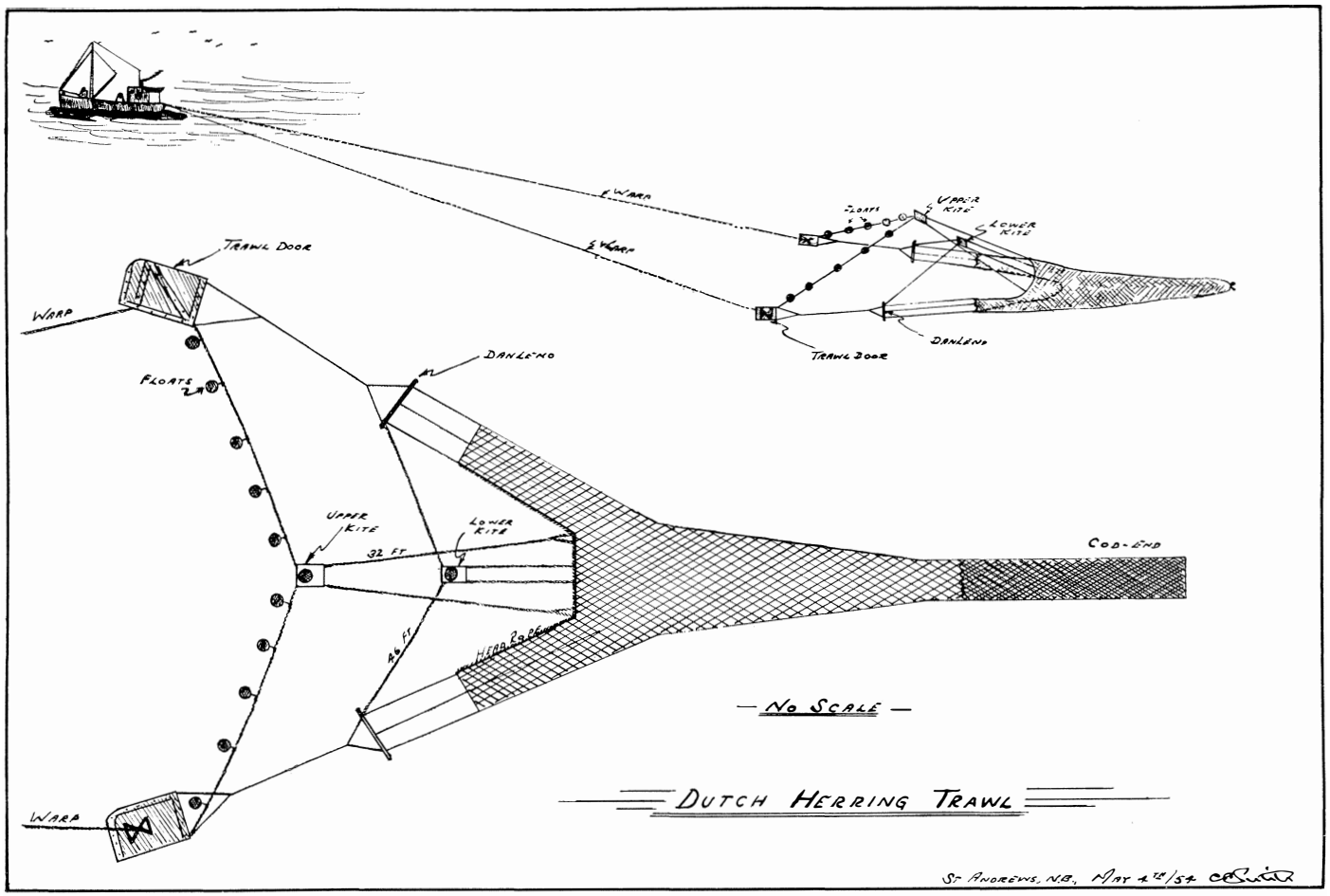


FIG. 19. Diagrammatic illustration of the construction and operation of a Dutch herring trawl. (From Leim *et al.*, 1957.)

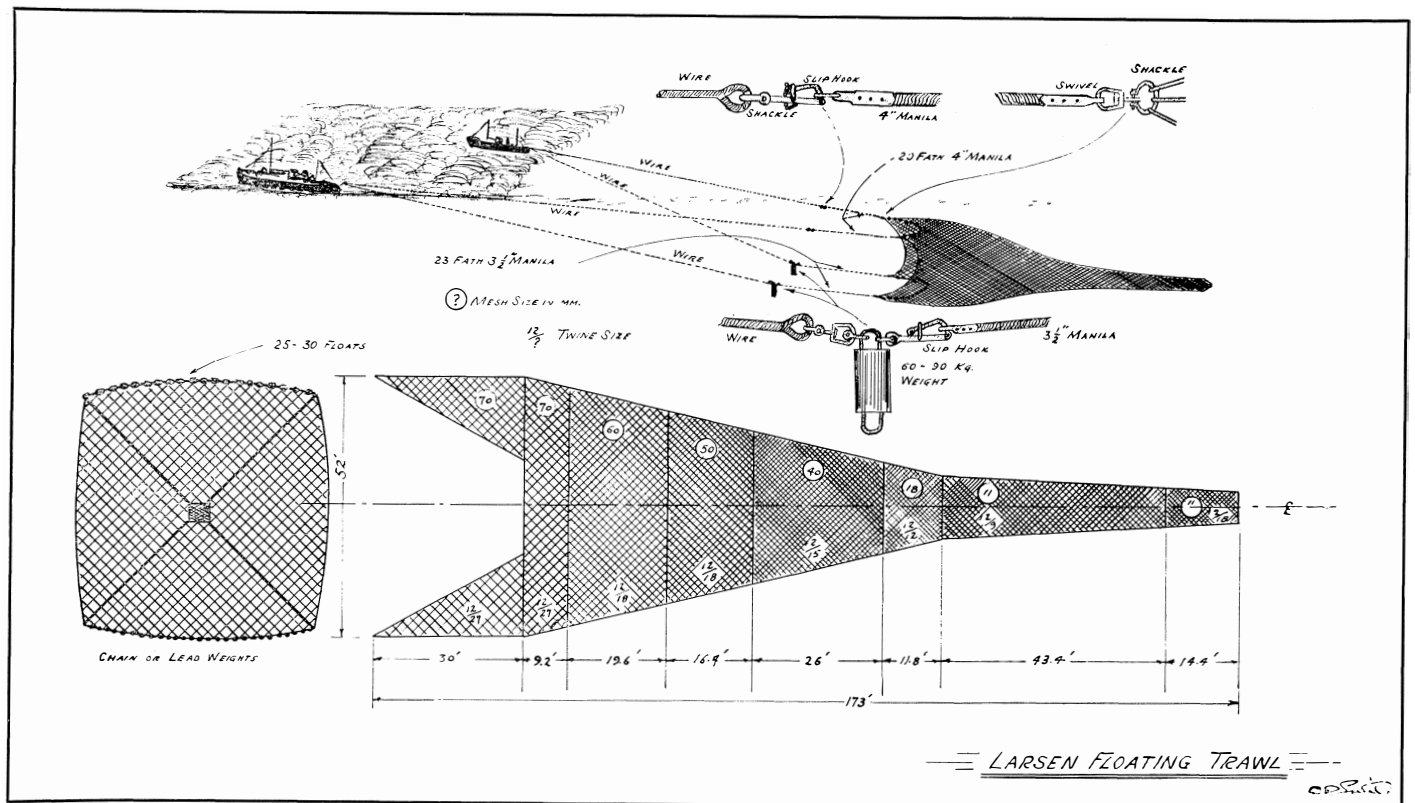


FIG. 20. Diagrammatic illustration of the construction and operation of the Larsen "floating" trawl. (From Leim *et al.*, 1957.)

UTILIZATION OF CATCHES

In the middle Atlantic section of the United States, the catches of herring are quite small. The fish are often marketed in a fresh condition, or they may be sent to fish meal plants if there is little immediate demand for the fresh fish. In New Jersey, the largest producer of herring in the middle Atlantic region, some of the fish are also frozen and sold as food for freshwater trout. In New York, where large quantities of pickled herring are imported to meet the demand, there is little effort to process the catch for human consumption, because quantities of herring landed vary considerably from year to year and would not profitably support a processing industry.

FIG. 21. Typical herring smoke house at Grand Manan. (Photograph by Dr. A. H. Leim.)

The New England states are relatively large producers of herring, which are utilized in a number of ways. In Rhode Island and Connecticut, most of the herring are sold for processing as fish meal and canned cat food, varying quantities are frozen as food for fur animals, especially mink; and small quantities are shipped to metropolitan areas to be sold fresh for human consumption. Massachusetts herring are marketed in a somewhat similar fashion. During World War II, some herring were canned as sardine and kippered snacks, but such operations in peacetime are seldom profitable in that state because of labor costs, lack of a dependable supply of fish, and competition from similar products that are more cheaply produced in Maine and foreign countries.

In Maine, most of the herring are used as sardines. Under present state legislative acts, it is illegal to catch and market herring under 4 inches in length

or to sell any herring for reduction purposes unless they are first offered to sardine-processing plants. These laws restrict the use of Maine herring for reduction; however, Maine fish meal plants are able to use small herring from Canada where no size regulations are in effect. Consequently, in Eastport, Maine, where most of the reduction plants are located, the preponderance of fish meal is derived from Canadian fish. Maine smokers and cat-food canners also depend to a great extent on imports of large Canadian fish, and this has been particularly true during the last ten years when large local herring have been quite scarce in the usual fishing areas. The absence of these fish has severely affected the pickled herring industry that flourished during World War II and for several years after. As an example of the present status of the utilization of Maine herring, 1956 statistics show that 90% by weight are canned as sardines, 8% are used as bait for the lobster fishery, and 2% for cat-food, fish meal, and smoked and pickled products. A by-product of the Maine and New Brunswick fishery is pearl essence, which is manufactured from the guanin crystals found on herring scales. The demand for pearl essence varies sharply from year to year and prices for scales may fluctuate from a few cents to over a dollar a pound. In the last few years, there has been only a limited market for scales.

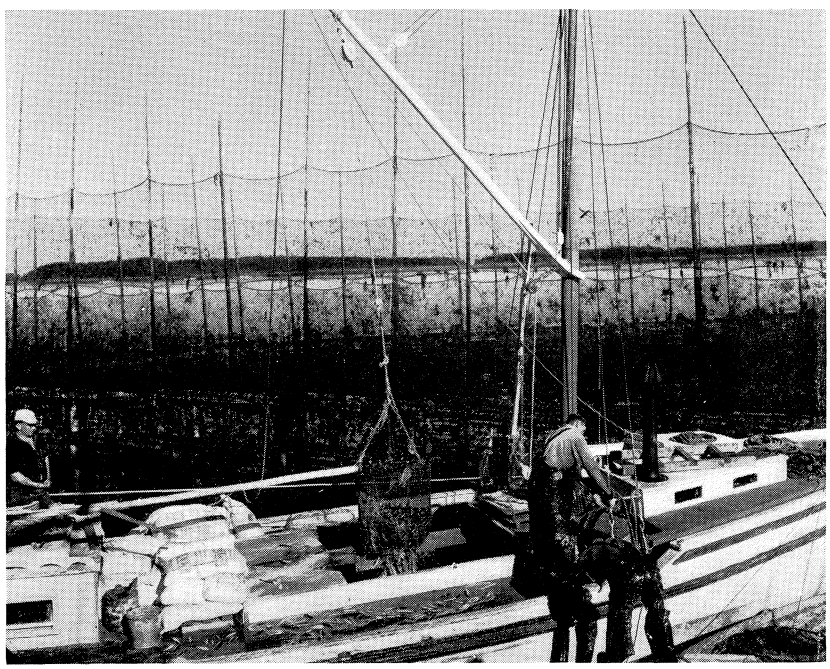
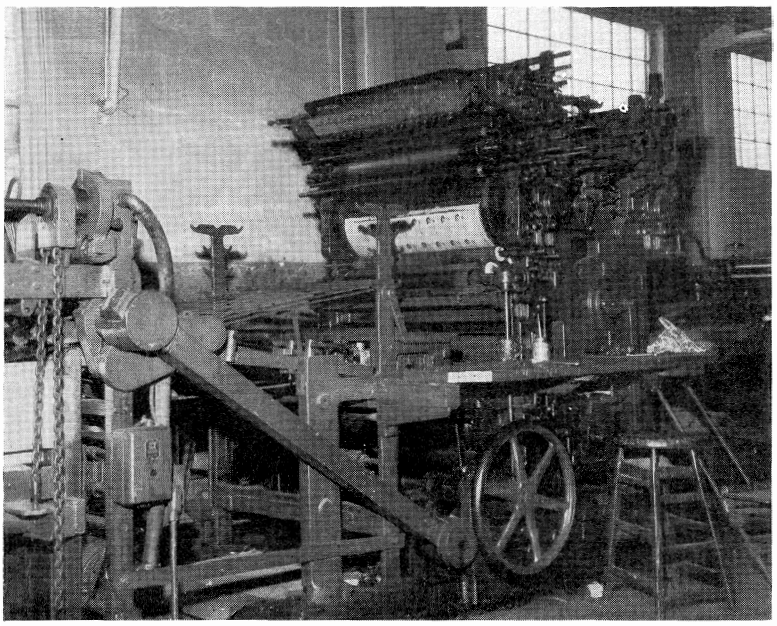


FIG. 22. Loading sardines from a weir into a carrier. (Photograph by National Film Board of Canada.)

In southern New Brunswick, the fishery is chiefly for immature herring. Most of the catch is canned as sardines, with the remainder used for lobster and groundfish bait or exported fresh. In recent years, a greater proportion of



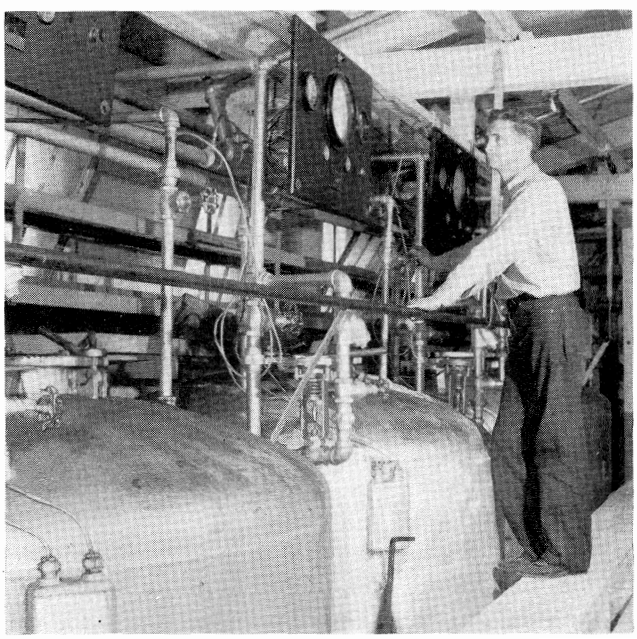


FIG. 23. The interior of a sardine cannery.
Above: A two-colour tin plate lithographing press.
Below: Steam retorts.
(Photographs by P. W. G. McMullon, courtesy Connor's Bros. Limited, Black's Harbour, N.B.)

the catch of sardines has been sent to Maine canneries and reduction plants. For example, in 1928 the total catch in Charlotte County amounted to 25,342 metric tons of which 80% was canned locally and the remainder sold as fresh or salted, whereas in 1946 from the total catch of 43,273 metric tons, 30,572 metric tons (71%) were exported fresh.

On the Atlantic coast of Nova Scotia, the herring fishery has been chiefly secondary to the groundfish fishery, with the majority of landings used for bait. With the post World War II conversion to otter trawling, the demand for herring for bait has declined, and recently most of the catch has been sold for food products (Tibbo, 1957b). Since 1950, there has been a considerable expansion in the herring fisheries of southwestern Nova Scotia, particularly in the Yarmouth, Shelburne and Queens County areas. The present catch (ca. 19,000 metric tons) is more than double the 1948 catch (ca. 7,600 metric tons). This is due to an increase in the demand for both large and small herring. Increasing quantities of the large herring are cured in vinegar and salt or are exported in fresh condition to Maine cat-food canners and reduction plants. The small herring are sold to Maine and New Brunswick sardine processors; some may also be used for reduction or cat food.

FIG. 24. Packing sardines in a Maine cannery (Photograph by Richard Merrill.)

In the southern Gulf of St. Lawrence, where from 23,000 to 27,000 metric tons are caught annually, 60% to 80% of the herring catch has been used for smoked bloaters and canned round herring and kippered snacks (Day, 1957b).

Since 1953, there has been a change in the utilization of herring at the Magdalen Islands where a meal and oil plant has been established, and the majority of the catches are now sold for reduction purposes.

In Chaleur Bay between New Brunswick and Quebec, about 36% of the herring catch is used for food as pickled, canned and fresh, and the remainder as bait and fertilizer (Tibbo, 1957a).

The north shore of the Gulf of St. Lawrence has a coastline of more than 500 miles, but is sparsely populated. The average annual catch of 213 metric tons is a small but an important part of the economy of the area. About 75% of the catch is processed as pickled herring in areas between Kegaska and Blanc Sablon, and the remainder is used for bait for a groundfish fishery on the banks and around Anticosti Island between Seven Islands and Natashkwan. In the Cap Chat and Rivière à Claude area, the bulk of the catch is pickled, while at Rivière au Renaud, 60% of the catch is frozen and later used as bait for an extensive groundfish fishery (Day, 1957b).

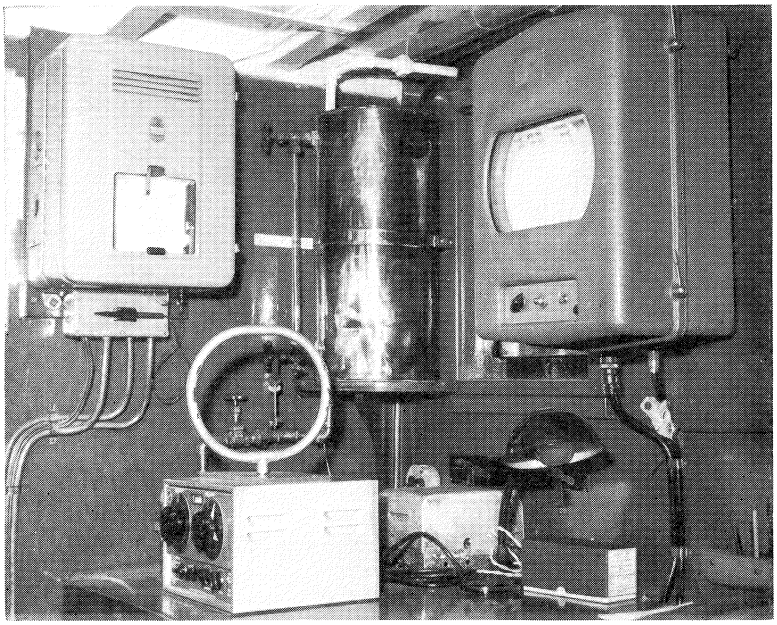
In Newfoundland, the herring fishery has been particularly important. In 1946, for example, 57% of all fish and fishery products exported consisted of herring. Herring are used extensively for bait in the lobster and cod fisheries, and large quantities are consumed locally. Exports of herring consist of fresh and frozen, pickled, smoked and canned products, and fish meal (Tibbo, 1956). The once-important winter trade in frozen herring from both the south and west coasts of Newfoundland to the United States has disappeared, and the catches are now used for local consumption, for bait, pickled products and for reduction to oil and meal.

FUTURE EXPANSION OF THE FISHERY

The problem of increasing the world's food supplies as the population grows has been considered seriously by fishery organizations during the past two decades. Considerable thought has been given to the possibilities of expanding fisheries to harvest new or relatively unexploited fish stocks and of properly using the presently exploited stocks. There appears to be no quick solution to the world's food problems, so we can anticipate a continuing interest in increased utilization of the resources of the sea.

The herring appears to be a possible source of more protein food. Our knowledge of the present herring fisheries on the Northwest Atlantic coast of the United States and Canada indicates that we catch most of these fish in inshore waters where they are often seasonally abundant. While the herring are living in the open sea, they are relatively free from exploitation, for no organized fishery exists on the offshore grounds. The possibilties of an offshore herring fishery have been considered for a long time (Moore, 1898), and in recent years both countries have sponsored explorations designed to discover the distribution and size of the schools and the feasibility of harvesting herring when they are not available to the inshore fishermen. These explorations carried out by the Fisheries Research Board of Canada and the United States Fish and Wildlife Service have demonstrated that commercial quantities of herring exist offshore and that the landings of herring could be augmented by catching them.

Since there is a need for more protein and there are herring that are not being utilized, why does not an increased fishery develop? The answer is an economic one. There is only a limited market for fresh herring for human consumption, and the price that the processing industry is willing to pay for herring is not enough to induce fishermen to abandon other more profitable fisheries. For example, during the summer months, otter trawlers catch whiting (*Merluccius bilinearis*) on the northern part of Georges Bank, a region where herring are also abundant. The whiting fishermen often trawl large quantities of herring, which are immediately dumped overboard and fishing resumed elsewhere, because there is more money to be made catching whiting than herring. The processing industry says that it cannot pay more for herring because of competition with other products. For example, herring fish meal is competitive with other meals from various countries and other species such as menhaden and pilchards. Similarly, salted and pickled herring must compete with imports from Europe. Because of the change in food habits of North Americans, it seems unlikely that much greater quantities of fresh, smoked, or pickled herring will be consumed in the immediate future. However, with a continuing increase in population, animal protein shortages may become more evident, and the demand for herring products, both as fish meal and human food, may become great enough so that the fishery will eventually be prosecuted to the utmost.



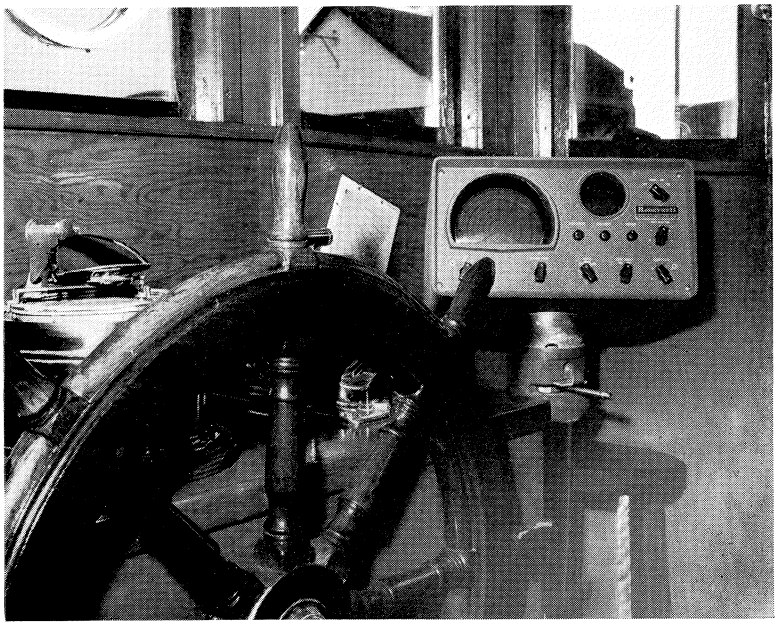


FIG. 25. Fish detection equipment on board a Canadian research vessel.
Above: Vertical sounding equipment
Below: Horizontal ranging equipment.
(Photographs by P. W. G. McMullon.)

When great quantities of herring can be landed profitably, we may anticipate that gear will be developed and improved to harvest the species in an increasingly efficient manner. Otter trawling techniques will be devised for fishing near the bottom and better mid-water trawls will be built. Old methods such as drift gill netting and purse seining may be utilized profitably, and there is the possibility that new techniques such as electro-fishing may be feasible. Improved knowledge of the general habits of herring including the locations and seasons of aggregations most suitable for fish will help substantially in making wiser use of this valuable resource.

REFERENCES

ALLEN, JOHN, THOMAS BARLOW, JOHN WARD, JR., AND LAUCHLAN DONALDSON. 1837. Reports of the Commissioners appointed by the House of Assembly to procure information respecting the state of the herring fishery at Grand Manan. *J. House of Assembly New Brunswick*, 1836-37, App. No. 2 pp. XIII-XVII.

DAY, L. R. 1957a. Populations of herring in the Northern Gulf of St. Lawrence. *Bull. Fish. Res. Bd. Canada*, No. 111, pp. 103-119.

1957b. Populations of herring in the Southern Gulf of St. Lawrence. *Ibid.*, No. 111, pp. 121-137.

DONALDSON, LAUCHLAN, JOHN WARD, THOMAS BARLOW, JAMES BROWN, THOMAS WYER, and JOHN ALLEN. 1837. Report of the Bay of Fundy deep-sea fisheries, prepared by the Commissioners appointed to inquire into the state of the herring fishery at Grand Manan. *J. House of Assembly New Brunswick* 1836-37, App. No. 2, pp. XVIII-XXXVI.

EARLL, R. EDWARD. 1887. The herring fishery and the sardine industry. *In* G. B. Goode. The Fisheries and Fishery Industries of the United States, Sec. 5,1: 417-542.

EARLL, R. EDWARD, and HUGH M. SMITH. 1889. The American sardine industry in 1886, *Bull. U. S. Fish Comm.*, **7**: *161-192.*

FOUND, W. A. 1912. The lobster fishery of Canada. *In* Sea-fisheries of Eastern Canada, Commission Conservation Canada, Ottawa, pp. 50-77.

INNIS, HAROLD A. 1954. The cod fisheries. The history of an international economy. Univ. of Toronto Press: pp. xv + 1-522.

JOSSELYN, JOSEPH. 1675. An account of two voyages to New-England. Second Addition. G. Widdowes, London. (Reprinted in *Coll. Massachusetts Hist. Soc.*, 1933, 3rd ser., **3**: 211-354.)

LEIM, A. H., S. N. TIBBO and L. R. DAY. 1957. Explorations for Herring in Canadian Atlantic Waters, 1945-1950. *Bull. Fish. Res. Bd. Canada, No.* 111, pp. 35-83.

MOORE, H. F. 1898. Observations on the herring and herring fisheries of the northeast coast, with special reference to the vicinity of Passamaquoddy Bay. *U.S. Comm. Fish and Fish., Commissioner's Rept. for* 1896, pp. 387-442.

PERLEY, M. H. 1850. Report on the sea and river fisheries of New Brunswick within the Gulf of St. Lawrence or Bay of Chaleur. J. Simpson, Frederickton, N. B. 137 pp.

SABINE, LORENZO. 1853. Report on the principal fisheries of the American seas. Robert Armstrong, Washington, 316 pp.

SAMUEL, ARTHUR MICHAEL. 1918. The herring; its effect on the history of Britain. J. Murray, London, xx + pp. 21-199.

SCATTERGOOD, LESLIE W. 1949. The production and the fishing methods of the Maine herring industry with notes on the 1947 season. *U. S. Fish and Wildlife Serv., Spec. Sci. Rept.*, No. 67, 26 pp.

SCATTERGOOD, LESLIE W., and PARKER S. TREFETHEN. 1952. A statistical summary of the Maine herring fishery in 1948 and 1949. *Res. Bull. Maine Dept. Sea and Shore Fish.*, No. 5, 62 pp.

SINDERMANN, CARL J. (In press). An epizootic in Gulf of Saint Lawrence fishes. *Trans. 23rd North American Wildlife Conf.*

SMITH, JEROME V.C. 1833. Natural history of the fishes of Massachusetts embracing a practical essay on angling. Allen and Ticknor, Boston, pp. vii + 399 p.

SMITH, JOHN. 1624. The generall historie of Virginia, New-England, and the Summer Isles with the names of the Adventurers, Planters and Governours from their first beginning An: 1584 to this present 1624. I.D. and I.H. for Michael Sparkes, London, pp. viii + 248.

STORER, D. HUMPHREYS. 1839. A report on the fishes of Massachusetts. *Boston J. Nat. Hist.*, **2**(3–4): 289-558.

TIBBO, S. N. 1956. Populations of herring (*Clupea harengus* L.) in Newfoundland waters. *J. Fish Res. Bd. Canada*, **13**(4): 449-466.

1957a. Herring of the Chaleur Bay area. *Bull. Fish. Res. Bd. Canada*, No. 111, pp. 85-102.

1957b. Contributions to the biology of herring (*Clupea harengus* L.) on the Atlantic Coast of Nova Scotia. *Ibid.*, No. 111, pp. 139-151.

1957c. Herring populations on the south and west coasts of Newfoundland. *Ibid.*, No. 111, pp. 153-164.

TIBBO, S. N., and E. G. SOLLOWS. MS, 1953. Drift-net fishing for herring, 1950 to 1952. *MS Rept., Fish. Res. Bd. Canada*, No. 505, 27 pp.