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REPORT ON THE SARDINE INDUSTRY IN RELATION TO
THE CANADIAN HERRING FISHERIES.

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The present investigation was undertaken at the suggestion of the Director of the Marine Biological Station of Canada, Professor Prince, Dominion Commissioner of Fisheries, the purpose in view being to determine whether or not the noticeable decline in the herring fisheries of the Bay of Fundy, and the western Nova Scotia coast, is attributable to the operation of the so-called sardine weirs, or brush traps, especially off the New Brunswick shores. In these weirs, which are really wicker-work inclosures, vast numbers of young fish, largely belonging to the Family Clupeidæ, are annually captured. Between seven and eight hundred of these traps are fished every season under licenses issued by the Dominion Government, and on some of the West Isles off Passamaquoddy Bay limited parts of the shore are thickly studded with these fish-weirs. It is alleged by fishermen in the waters further north, especially in St. John County, N.B., that there has been a serious decrease in the supply of full-grown herring, indeed that certain schools, which provided important fisheries in former years, have totally disappeared. In Digby County, N.S., a similar allegation is made. 'How can you expect the herring in the upper part of the Bay of Fundy and in the Annapolis Basin and St. Mary's Bay to continue plentiful, if they are destroyed and exterminated in the New Brunswick sardine weirs before reaching maturity?' wrote a prominent authority in Nova Scotia not long ago. Professor Prince in a special report to the Honourable the Minister of Marine and Fisheries in 1895 referred to this alleged injury in the following terms (28th Annual Report of the Department of Marine and Fisheries, pp. xxxi. and xxxii.) :—

'It is doubtful whether any fishery can withstand for long so serious a drain upon immature individuals. No doubt the hardy nature of the herring's eggs and fry help to keep up the numbers; but other species of fish in the sea would succumb were specimens that had never spawned captured in such vast quantities. All efforts to diminish the supply of herring here, as in Great Britain, have had apparently little effect. Some authorities have explained the non-appearance of the large winter herring in the Bay of Fundy, as for example in 1891, by the continued destruction of small fish for sardine purposes. The run of sardines also has shown at times a very marked diminution, but not more than may be attributed to the ordinary fluctuations of such a fishery. Indeed, it is a striking fact that in the years 1890-91 these small fishes were more abundant than they had been for twenty years previously.

It cannot, therefore, be said that the capture annually of vast quantities of immature fish has had any serious effects. The possibility is suggested that a considerable proportion of these small fishes may belong to other Clupeoids, though this is contrary to the common opinion of those engaged in the sardine industry.

It is still an open question, therefore, whether this destruction, on a large and increasing scale is or is not calculated ultimately to endanger the supply of large herring. If schools of young are killed off before they have reached the spawning age, the general catch of the future must ere long be affected.'

The matter is one of great importance, as, on the one hand, the so-called 'sardine' fishermen, who form a considerable body on the Charlotte County shores, derive a large part of their income from the weir returns, and, it may be added, the United States sardine industry centred at Eastport and Lubeck, in the State of Maine, but also carried on at Milbridge, Jonesport and Machiasport, depends largely upon supplies of fish from the Canadian fishermen. As Professor Prince, in his report referred to above, says (pp. xxvi. and xxvii.): 'The United States canneries could not carry on their operations for a single day but for the ample supplies of fish obtained from our waters, and the sardine industry, so far as our fishermen are concerned, is confined to the capture of the fresh fish and their disposal to the Maine canneries. At least ninety-five per cent of the so-called United States sardines are caught by our fishermen on Canadian shores, and these are, for the most part, packed in Eastport, Lubeck and other small towns in the State of Maine.'

Of such importance is the supply of these small fishes that a large proportion of the population on the Maine coast, as well as the body of Canadian fishermen who pursue their calling amongst the islands of the Bay of Fundy and neighbouring waters, may be said to be largely dependent upon the sardine industry. A failure in the supply of these fishes would mean disaster to those engaged in cleaning, curing and packing, and who have capital invested in the canneries, and would, without doubt, seriously affect the Canadian fishermen who find lucrative employment in the capture of the sardines. That the small fish, known as sardines in these waters, were abundant on the shores of Charlotte County, N.B., was long known to our fishermen, but their value was not appreciated, and the only use to which they were turned was that of conversion into manure for the purpose of fertilizing the land.

On the other hand a considerable number of N.B. and N.S. fishermen claim that they have suffered injury from this alleged capture of small fish, and as the matter had never been systematically looked into, it was my object to examine as far as possible the catches from certain weirs, and to ascertain what species of fish were really captured for the purposes of the sardine canning industry.

With this end in view, it was desirable to ascertain, in the first place, the character of the fish used as sardines, and, in the second, the extent to which these and other clupeoid fishes are affected by the operation of the brush weirs. Accordingly samples of the catch were obtained from fishermen in charge of the weirs, at different times during the month of August, and under different conditions. All of the fish examined were taken from weirs in the immediate vicinity of the Canadian Marine Station then located at St. Andrews, New Brunswick. Below is given a summary of the results obtained.

On August 1 an average series of 31 specimens from Malloch's weir, off Indian Point showed the following composition :—

Species.	No. of Specimens.	Size (length).
		inches.
<i>Clupea harengus</i> , L. (Common herring).....	29	5½—7
<i>Pomolobus pseudoharengus</i> , Wilson (Alewife).	1	8½
<i>Microgadus tomcod</i> , Walbaum? (Tom-cod, Frost-fish)	1	11

The query placed opposite the Tom-cod indicates that in certain important diagnostic features this specimen did not correspond with the description of *Microgadus tom-cod* in Professor D. S. Jordan's Manual of the Vertebrate Animals of the Northern United States, 5th edition, Chicago, in respect, for example, to the number of rays in the three

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divisions of the dorsal fin (14-20-20) and in the relation of the eye to the head (6) as given in the work mentioned (p. 163).

On August 4 a lot of 286 specimens from Quinn's weir was made up as follows:—

Species.	Number of Specimens.	Size.
<i>Clupea harengus</i> , L.	285	263, 5-7 in. ; 22, 8-9½ in.
<i>Osmerus mordax</i> , Mitchill.	1	10 in.

On August 5 a sample was received from Miller's weir on the south side of Navy Island near St. Andrews, the fishermen having been instructed to bring specimens of all of the varieties of fish taken. This lot was made up as follows:—

Species.	Number of Specimens.	Size.
<i>Melanogrammus aeglefinus</i> , L. (Common haddock).	1	11 in.
<i>Microgadus tom-cod</i> , Walb.	1	13 in.
<i>Osmerus mordax</i> , Mitchill.	2	10-12 in.
<i>Gadus callarias</i> , L. (Codfish).	2	11-13 in.
<i>Pollachius virens</i> , L. (Pollack).	4	8-11 in.
<i>Clupea harengus</i> , L.	179	3, 11-12 in.; 176, 4½-7 in.

On August 9 a small sample of the catch, consisting of five fish, was received from Malloch's weir, as follows:—

Species.	Number of Specimens.	Size.
<i>Scomber scombrus</i> , (Mackerel)	1	14 in.
<i>Clupea</i> , sp. ?	2	7½-8½ in.
<i>Pomolobus pseudoharengus</i>	1	8½ in.
<i>Clupea harengus</i>	1	10 in.

I may remark that the specimens marked with a '?' corresponded to the description of *C. aestivalis* in Jordan's Manual, 5th ed., p. 72, except in the relation of the head to the length; (Head 4), a detail probably subject to no little variation.

On August 14 seven especially large specimens of *C. harengus* were received from Quinn's weir. These ranged from 11 to 14 inches in length, and on dissection I found that the ova in the females were almost mature.

On August 15 a sample was received from Malloch's weir which had been taken on a night tide. This was made up entirely of *C. harengus*, of which there were 211 ranging in size from 5 to 7 inches, and four ranging from 8 to 10 inches.

On August 26 a small selection consisting of five fish was received from Malloch's weir, composed as follows :—

Species.	No. of Specimens.	Size.
		inches.
<i>Clupea</i> sp.?	3	8½—9½
<i>Pomolobus pseudoharengus</i> , Wilson	1	9
<i>Rhombus triacanthus</i> , Peck (Dollar-fish)	1	5¾

It is apparent from the above facts, limited though they undoubtedly were, that the bulk of the catch of the brush weirs consist of the 5 to 7 inch young of the common herring (*Clupea harengus*), and that these provide the material for the sardine industry. The young of other clupeoid fishes do not appear to be affected, if one may judge by the average selections sent to the Biological Station, by the operation of the weirs and the adults of all only slightly. Further study is necessary, however, before a final decision could be finally rendered on this point, as there may be a variation in different seasons. A more lengthy investigation extending over several seasons would be more conclusive. As noticed above, all the specimens examined were taken in the immediate vicinity of St. Andrews and during the month of August alone, and it may be possible, therefore, that the character of the catch may vary considerably at different points on the coast and at different periods of the sardine season. It is clear, in the case of the common herring, that the removal of such enormous numbers of the young in the sardine industry must be a very considerable drain on the supply however rapid the rate of increase may be. Whether this is the essential factor in the decline of the herring fishery alleged to have occurred in certain parts of the Bay of Fundy must remain doubtful, however, until adequate causes of decline can be assigned in the case of other clupeoid fishes.

An impression is stated to have, at one time, prevailed that the small fish used as sardines, are not the young of any larger species, but a diminutive kind of herring, which never exceeds a size of nine or ten inches.

The true sardine has, of course, never yet been recorded on our Atlantic coast, the so-called sardine in Florida being really an Atherine or kind of 'Silversides' scientifically known as *Atherina stipes (laticeps)*. On the Pacific coast, moreover a small Clupeoid occurs, viz. : *Clupanodon caeruleus*, Girard, usually known as the Californian sardine. The anchovy (*Engraulis mordax*, Girard) also occurs and is canned in the United States under the name of sardine ; but in British Columbia neither of these fishes has been turned to commercial account.

The growth of the Maine sardine industry has been remarkable especially in view of the fact that the major part of the raw material comes from our Canadian waters. From 1875 to 1880 it is stated (C. H. Stevenson, *Bullet. U. S. Fish Commiss.* xviii., 1898, p. 526) that there were only five sardine canneries in Maine ; but in 1880 the number rose to eighteen. In 1886 twenty-seven more establishments began operations. This number (45) fell in 1889 to thirty-seven ; but in 1892 increased to forty-six, while in 1898 there were no less than sixty-two of these canneries putting up so-called sardines. The average value is stated by Mr. Stevenson, in the report above referred to, as \$2,000,000 per annum ; but in 1898 the value rose to \$2,727,781, and in 1899 the *New York Fishing Gazette* estimated it to be not less than \$3,000,000, the factories being chiefly confined to the towns of Eastport and Lubeck, which practically maintain their existence as flourishing business centres through this one industry.