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The Canadian fisheries exploiting the southwestern Nova Scotia Div. 4X-4W herring stock

by

D.S. Miller

Fisheries Research Board of Canada
Biological Station, St. Andrews, N.B.

Introduction

The herring fisheries of southwest Nova Scotia exploit a stock which is also subject to a foreign fishery on the Scotian Shelf in divisions 4X and 4W. The foreign fishery is highly mobile employing purse seines and midwater trawls. The Canadian fisheries employ a variety of gears which can be grouped into three main categories; purse seines and midwater trawls, weirs and gill nets. The purse seine-midwater trawl fishery developed during the mid-fifties and early sixties and has caused a substantial increase in total Canadian landings reaching a peak total (weir and purse seine-midwater trawl) in 1968 of 134,000 tons. The fishery begins in June to the north and south of the spawning area and moves into the spawning area by late August (Iles and Miller, ICNAF Res. Doc. 72/11). The major portion of the catch is taken in the third quarter. The weir fishery takes place in the St. Mary's Bay-Digby Neck area with the catch split equally between the second and third quarter. Catches have fluctuated around 10,000 tons a year from this fishery. The gill net fishery takes place around the southern tip of Nova Scotia during the second and third quarters exploiting local fall spawning populations and is assumed not to contribute to the fishing mortality on the main Nova Scotia stock (Report of the Herring Working Group, Annual Meeting, 1972).

The age and length composition of the Nova Scotia has been described for the period 1956-1967 (Messieh, Burnett and Tibbo), but their analysis did not weight the sampling data by catch amounts due to the lack of accurate catch statistics. This paper describes the age and length composition of the Canadian catch from this stock for the

period 1965-1971 and provides estimates of numbers and weight caught in each age group. All age and length distributions have been weighted by gear and catch.

Catches and landings

Canadian weir, purse seine-midwater trawl catches were determined on a monthly basis using a similar technique to that of Iles (ICNAF Res. Doc. 72/12). The catches were summarized on a quarterly basis as there was insufficient sampling data for several years to allow monthly treatment of catches. For certain years a significant proportion of the catch was recorded as unknown gear and this was split up amongst the known gear types in proportion to the total known catch. Canadian catches from the stock (Table 1) increased throughout the sixties with a peak catch of 134,000 tons in 1968 and then declined to only 43,000 tons in 1971. The stock came under ICNAF quota control in 1972. Up to 1969 Canada took virtually all of the total catch from this stock. During the period 1969 to 1972 when foreign effort took a significant catch from the stock, Canada remained the major exploiter taking 288,000 tons or 69% of the total . U.S.S.R. has the major foreign fishery taking 120,000 tons during the same period or 29% of the total. Japan, Germany (FR), German Democratic Republic and Poland each took a portion of the remaining 1% of the total catch. During the period 1965 to 1972, the Canadian purse seine-midwater trawl fishery accounted for 89% of the total Canadian take from the stock while the weir fishery took only 11%.

Size and age composition of catches and numbers removed from the stock

As indicated by Iles and Miller (ICNAF Res. Doc. 72/11) and Iles (ICNAF Res. Doc. 72/12) the spatial and seasonal interaction of separate elements of the fishing in the Nova Scotia area is very complex. Over much of the period biological sampling data has been inadequate to allow proper weighting of catches on a monthly basis. Table 2 lists the sampling data available for the Canadian catch for the period 1965-1971. Age length material was summarized for the total 4X catch ignoring gear as there was insufficient data for individual age length keys for each gear type. Ages were grouped from 1 to 8 with an additional 8+ category but age one fish were deleted in the subsequent summaries as only a small percentage show in the catches at this age and is not indicative of incoming year class strength. Lengths were grouped to the centimeter below. Age, length and weight samples were summarized on a quarterly basis as there was insufficient sampling data for a monthly breakdown. Length-weight data for the period 1969-1971 was summarized to give an

average length-weight table which was used for all conversion of catches to numbers caught in each age group. Length frequency data was summarized by gear type with purse seine and midwater trawl samples being combined in one group as there was no appreciable difference in length distributions between them. For several years, a small catch occurred in the first and fourth quarters for which there was no length frequency samples. In these cases, the catch were put in the second and third quarters respectively and applied to that sampling data.

Year class variability in the Nova Scotia stock is characterized by above average strength year classes at intervals of two or three years. Table 3 lists the age composition of the catch for the period 1965-1971 as represented in Figure 1. The data clearly shows a good 1961, 1963 and 1966 year class and a slightly better that average 1968 year class. In the period 1960-1965 when the purse seine-midwater trawl fishery was in the developmental stage, catches were low and there was low exploitation of the two year old juveniles. This resulted in a large stock of three year old and five year old fish (i.e. 1963 and 1961 year classes) being available to the fishery at the start of the 1966 season, i.e. by having a relatively low fishing mortality on these year classes as juveniles, they were able to contribute to the fishery as adults realizing their growth potential. The period 1966 to 1968 was characterized by a large increase in fishing effort and catch within the fishery mainly to supply the newly developing fish meal industry in southern Nova Scotia. By 1968, the fishery reached its peak catch with the major weight portion of the catch provided by the good 1961 and 1963 year classes. During 1968 there was also a very large catch (630 million individuals) of the 1966 year class as two year olds but as they were small fish they contributed relatively little to the weight composition of the catch. This high exploitation of the 1966 year class as juveniles was responsible for a reduced contribution of the year class to the fishery as adults, especially during the years 1970 and 1971 when as four and five year olds the year class should have been making its major weight contribution to the fishery. Table 4 lists the weight contribution to the fishery of each year class as different ages. If we consider the weight contribution to the fishery of a year class between the ages of four and six, the 1961 and 1963 year class contributed 158 and 100 thousand tons respectively whereas the heavily exploited juvenile 1966 year class was only able to contribute 48 thousand tons during the same age period.

Preliminary analysis of the 1972 catch has indicated a high mortality on herring under 22 cm in length, 470 million individuals being caught. This would indicate the probability of another strong year class entering the fishery but again like the 1966 year class being over exploited as juveniles.

It is evident that in order to obtain the maximum sustainable yield from this stock it will be necessary for any management scheme to reduce the high juvenile mortality as contributed by the purse seine-midwater trawl fishery in past years. Any large incoming juvenile year classes will then be able to realize its growth potential contributing substantially more to the fishery as adults.

Table 1. S.W. Nova Scotia - 4Wb herring catches by gear 1963-1971.
(In metric tons)

	1963	1964	1965	1966	1967	1968	1969	1970	1971
Weir	5340	12427	14062	7735	12525	12500	10785	11862	8113
Purse seine and midwater trawl	15101	24902	52356	113313	117089	121323	76382	70008	35312
Gill net	6338	7365	9383	7044	8666	8439	5124	7289	6500
Total	26779	44694	75801	128092	138280	142262	92291	89159	49925
Foreign	2964	2472	5928	2417	598	2756	14563	59903	24333
Total	29743	47166	81729	130509	138878	145018	106854	149062	74258

Table 2. Sampling data for the S.W. Nova Scotia fishery
1965-1971

Year	Purse Seine & Midwater Trawl Length Frequency		Weir Length Frequency		Age Length (Total 4X)	
	No. Measured	No. of Samples	No. Measured	No. of Samples	No. Aged	No. of Samples
1965	4124	26	2902	16	4697	74
1966	4708	31	1707	16	3677	70
1967	5461	23	3090	24	5263	87
1968	10583	34	2947	20	4835	89
1969	45982	196	4933	20	9133	97
1970	49376	186	9166	48	10153	133
1971	12106	79	6495	34	8597	99

Table 3. Age composition (in millions) of S.W. Nova Scotia weir and purse seine-midwater trawl catches 1965-1971.

AGE/GEAR		1965	1966	1967	1968	1969	1970	1971
2	Weir	66.4	2.2	12.4	83.8	32.4	26.3	9.1
	PS-MWT	241.4	48.9	56.1	554.1	22.2	31.3	7.1
	Total	307.8	51.1	68.5	637.9	54.6	57.6	16.2
3	Weir	12.0	39.4	11.9	11.9	91.1	2.4	14.1
	PS-MWT	20.2	296.2	36.9	85.9	192.6	6.8	27.3
	Total	32.2	335.6	48.8	97.8	283.7	9.2	41.4
4	Weir	41.4	8.3	38.3	9.8	10.2	23.1	7.1
	PS-MWT	168.1	47.6	195.3	65.2	35.9	139.6	28.3
	Total	209.5	55.9	233.6	75.0	46.1	162.7	35.4
5	Weir	10.9	16.8	13.4	21.2	6.9	10.8	7.8
	PS-MWT	35.4	269.8	122.5	241.0	95.9	78.0	41.3
	Total	46.3	286.6	135.9	262.2	102.8	88.8	49.1
6	Weir	2.9	1.2	11.5	5.3	3.0	9.9	3.9
	PS-MWT	7.1	44.6	159.9	54.4	49.1	45.9	19.0
	Total	10.0	45.8	171.4	59.7	52.1	55.8	22.9
7	Weir	0.8	0.1	2.6	6.5	1.6	4.4	5.9
	PS-MWT	0.8	6.0	35.6	59.6	35.9	23.9	23.1
	Total	1.6	6.1	38.2	66.2	37.5	28.3	29.0
8	Weir	0.2	0.0	0.6	1.9	0.5	1.8	1.3
	PS-MWT	0.1	6.1	4.5	21.4	12.2	11.2	6.7
	Total	0.3	6.1	5.1	23.3	12.7	13.0	8.0
8+	Weir	0.0	0.0	0.2	0.5	0.1	0.3	0.4
	PS-MWT	0.0	4.4	0.6	13.6	2.8	3.6	2.8
	Total	0.0	4.4	0.8	14.1	2.9	3.9	3.2

PS - Purse seine
MWT - Midwater trawl

Table 4. Age composition of catch expressed as weight in thousands of metric tons - 1965-1971. (Weir, purse seine-midwater trawl)

AGE	1965	1966	1967	1968	1969	1970	1971
2	5.5	1.8	2.7	15.2	1.5	2.4	0.8
3	2.1	19.9	3.5	6.2	25.2	1.0	5.8
4	43.1	8.6	34.8	11.9	6.6	28.9	6.9
5	11.7	69.3	28.5	52.0	22.4	19.6	11.2
6	3.2	15.5	46.2	15.6	13.6	14.9	6.1
7	0.6	2.1	11.7	19.8	11.9	8.7	8.6
8	0.1	2.4	1.7	7.6	4.2	4.6	2.7
8+	0.0	1.5	0.3	5.4	1.0	1.5	1.2

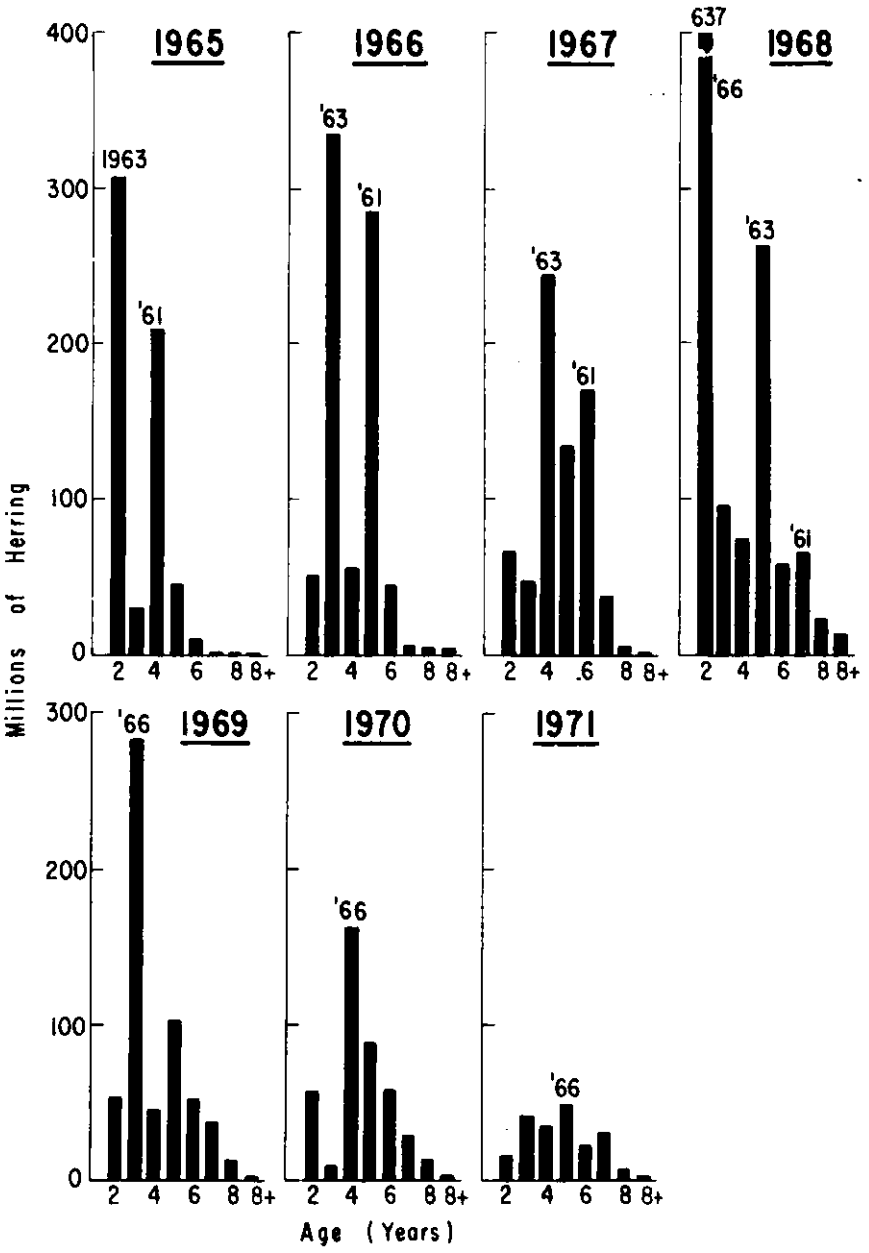

Fig. 1. Age composition of combined weir and purse seine-midwater trawl catch 1965-71.

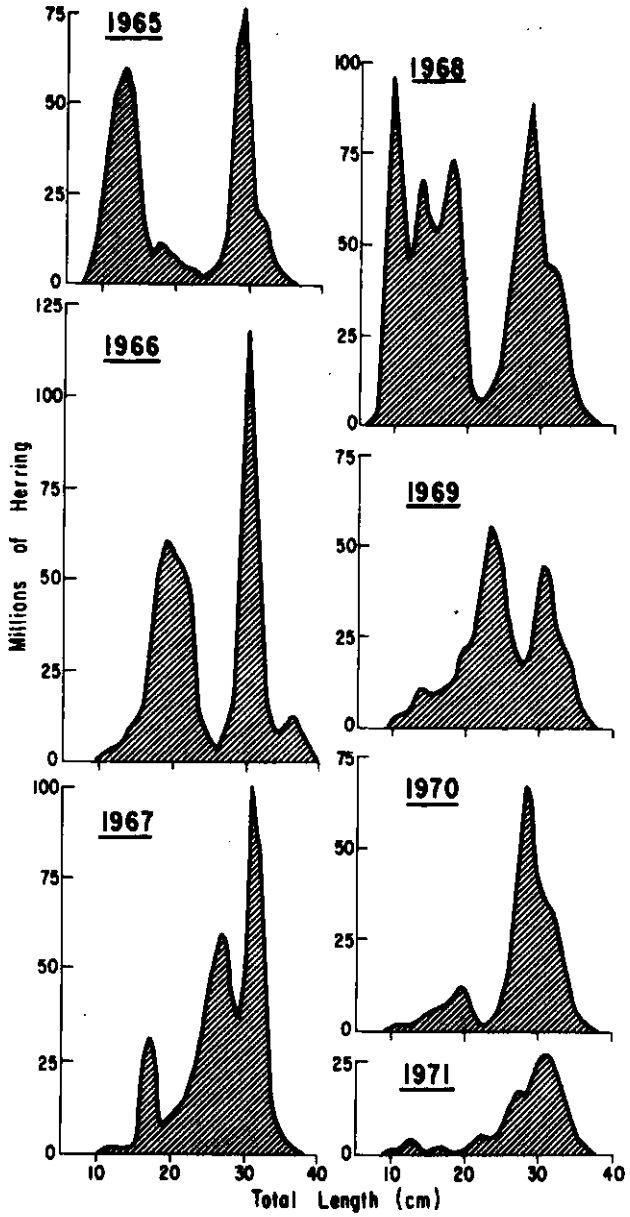

Fig. 2. Length composition of combined weir and purse seine-midwater trawl catch 1965-71.

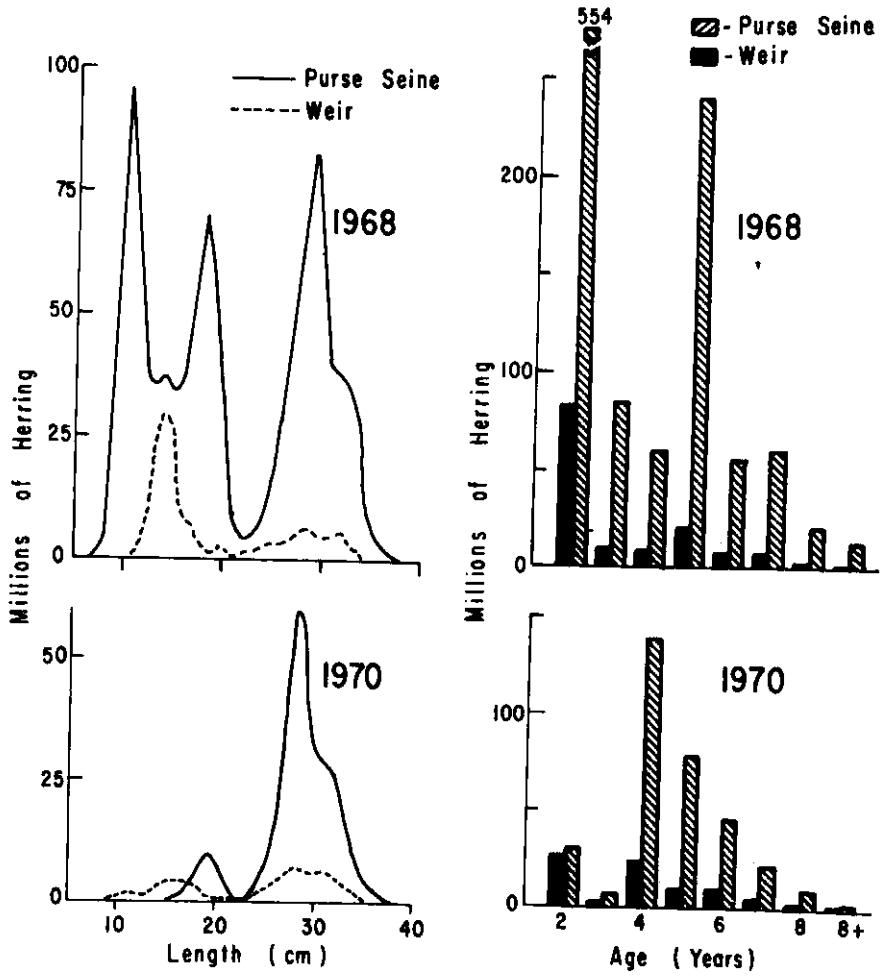

Fig. 3. Age and length distributions by gear for 1968 and 1970.