

International Commission for



the Northwest Atlantic Fisheries

Serial No. 3159
(D.c.3)

ICNAF Res.Doc. 74/13
(Revised)

ANNUAL MEETING - JUNE 1974

An Assessment of the 4X-4Wb Herring Stock¹

by

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Herring fisheries in the Bay of Fundy date back to the earliest visits of European fishermen over 400 years ago. The earliest fishery for herring was mainly by gill-nets with the modern weir fishery beginning about 1820. During the late 1940's, a purse seine fishery developed on the New Brunswick side of the Bay of Fundy in the Campobello Island area. This fishery expanded during the 1950's and supplied a pet food-fish meal industry located in Eastport, Maine. In the early 1960's this industry relocated to the south and a Canadian fish meal industry began to develop to provide production facilities to meet the increased catch capability of the expanding fleet. In 1964, a large fish meal plant was built in Pubnico in S.W. Nova Scotia. This marked the beginning of a rapid increase in the S.W. Nova Scotia purse seine fishery to meet the increased demand for herring for reduction.

The weir fishery occurs on both sides of the Bay of Fundy, and supplies the sardine food industry located in the Black's Harbour area. Surplus amounts generally find their way to the U.S. market where they are also used by the food industry there. Weir catches fluctuate greatly from year to year, generally the good catches tend to indicate incoming year classes of above average strength. The New Brunswick fishery which is almost totally dependent on age three and younger fish tends to show the greatest variation in catch, whereas the Nova Scotia fishery, which takes a higher proportion of adults, fluctuates to a lesser degree.

The gillnet fishery takes place on the Nova Scotia side of the Bay and exploits adult fish. This fishery supplies both lobster bait and the herring-pickling industry located in Nova Scotia. The catches tend to be relatively constant varying between 5,000 and 8,000 tons a year.

The purse seine-midwater trawl fisheries take place on both sides of the Bay but midwater trawling has accounted for only a small part of the catch. A fall-winter herring brit fishery took place on the New Brunswick side during the 1960's. This fishery exploited juvenile fish under 15 centimeters and supplied fish-meal plants located in the United States. The peak catch was only 45,000 tons in 1968, but removals by number were very high due to the small size of the fish. This fishery was essentially ended in 1970 by Canadian legislation preventing landing of herring under 4 1/2 inches (11.43 cm) and utilization of catches of herring 4 1/2 - 7 inches as fish meal. A summer-fall fishery occurs on the Nova Scotia side of the Bay exploiting both juveniles and adults. This fishery supplies both food and fishmeal plants in Canada and the United States. The fishery increased greatly during the 1960's with a peak catch of 129,000 metric tons in 1968. This fishery came under ICNAF quota regulation in 1972. A new fishery developed on the Grand Manan Banks in 1972 taking fish of essentially the same length distribution as the Nova Scotia fishery. This fishery also supplies both Canadian and United States food and fishmeal interests. It is considered to be under the same quota as the southwest Nova Scotia fishery.

Sampling

The Canadian Bay of Fundy fisheries have been sampled for both length composition and age-length data as listed in Table 2. Sampling in the 1960's was poor and

¹ Revision of Res.Doc. 74/13 presented to the Fourth Special Commission Meeting, FAO, Rome, January 1974.

there are large gaps in the data covering certain periods of the fishery. Sampling from 1970 to date has been much more intense and gives a much better coverage of the catch. Sampling data for the foreign fisheries were used from the ICNAF sampling yearbooks. All foreign catches were combined and used to weight the combined foreign sampling data. Prior to 1969 there was insufficient foreign sampling data to convert catches to numbers at age and as catches were generally small (less than 2,000 metric tons) they were omitted from the analysis. Each fishery was treated separately and length frequencies were weighted by catch on a monthly basis. Where no samples were taken in a month but catches did occur, those catches were applied to the nearest month based on the growing season of the fish. Length-weight data from the period 1969-1973 were combined for an average weight at length key. For months having a smaller range of weight at length data than the commercial length frequency samples, extrapolated values were used from fitted curves of the form $W = aL^n$. (Iles and Miller, ICNAF Res. Doc. 73/92).

Age length keys were constructed using total 4X sampling data. These were on a quarterly basis up to 1972. Sampling in 1973 was sufficiently good to construct a monthly key. Catch and landing statistics for the Bay of Fundy have been poor. A technique similar to that used by Iles (ICNAF Res. Doc. 72/12) was used to estimate monthly catches from 1963 to date. Some differences in figures did occur due to different interpretation of the data but catches are generally comparable. Monthly catches for the various components of the fishery are listed in Tables 3a through 3h. Numbers of fish taken by length groups for the various components of the total fishery are listed in Tables 4a through 4g. Number of fish taken in each age group are listed by each fishery for the period 1965-1973 in Tables 5a through 5g.

Sex and maturity stage data were analysed for the period 1971 to 1973. These data are presented in Table 6 for the August-September period by age group. The data from the three years are similar and indicate that from 30 to 35 percent of age 3 fish, 85 to 90 percent of age 4 fish, and 90 to 95 percent of age 5 fish will recruit to the spawning stock.

Catch per Unit Effort (C.U.E.) Data

Log records for the southwest Nova Scotia purse seine fishery were analysed for the period 1966 to 1973. These data are presented in Table 6. The individual catch and effort data were assigned to 10 degree squares in a technique similar to that used by Iles and Miller (ICNAF Res. Doc. 72/11). In 1973, logbook coverage of the fishery was very poor and the effort data were supplemented by Fishery Officer reports of individual boat interviews listing catch and effort data. The 1973 catch was therefore treated three ways using logbook data, Fishery Officer report data, and a combination of both. Catch per unit effort by months was very similar except for July when the Fishery Officer reports showed a substantially higher C.U.E. than from the logbooks. It was decided that the combined data presented the best picture with July having a higher value than indicated by using the logbook data alone.

Since the 1973 fishery ended in August due to quota level being reached, the annual mean C.U.E. was not comparable to previous years which included a continuation of effort on into September with relatively high catch rates. A mean of June, July, and August C.U.E.'s for each year from 1966 to 1971 was taken and these were expressed as a percentage of the total C.U.E. and a mean was taken of these percentages. The year 1972 was not included as there was an unusual late fall fishery with very high C.U.E. which was not comparable with previous years. The mean of the percentages was then used to weight up the annual C.U.E. figure for 1973.

Growth

There are growth differences among years for Bay of Fundy herring of the same age, and also differences among areas for different groups of fish of the same year class, which have yet to be adequately described. Combining length-at-age data from all Canadian Bay of Fundy fisheries in the 1963-1972 period gives the following average mean lengths-at-age in the third quarter (July-September):

<u>Age</u>	<u>Mean Length (cm)</u>	<u>Age</u>	<u>Mean Length (cm)</u>
1	10.55	6	32.07
2	15.72	7	33.00
3	22.65	8	34.04
4	27.46	9	34.71
5	29.72	10	35.87

These data give the following von Bertalanffy growth equation:

$$L_t = 37.33 (1 - e^{-0.315(t-0.031)})$$

$L_\infty = 37.33$ cm is equivalent to $W_\infty = 412$ gm.

Detailed data on mean length and mean weight at age, by months and sections of the fishery for 1965-1973 are available from the authors.

Yield-per-recruit

A yield isopleth diagram (Fig. 1) was constructed using the Beverton and Holt yield per recruit model with the following parameters:

$M = 0.20$ (natural mortality)

$W_\infty = 412$ gm

$K = 0.315$

$t_0 = 0.030$

$t_p = 1.0$ yr (age at recruitment to the exploited area)

$t_p^1 = 1.0-8.0$ yrs (mean age at recruitment to the fishery)

$t_\lambda = 10.0$ yrs (last age of significant contribution to the fishery)

Maximum yield per recruit is obtained at $F = 0.25-0.40$, when mean age at recruitment to the fishery occurs at ages 1-2, and at $F = 0.50$ or greater when age at recruitment is higher than age 2.5.

STOCK RELATIONSHIPS AND DEFINITION OF STOCK UNDER CATCH QUOTA

Current stock hypotheses assign the following fishery components to the main S.W. Nova Scotia herring stock:

- Nova Scotia purse seine catches
- Nova Scotia weir (and trap) catches
- Nova Scotia gillnet catches from west of Shelburne
- Grand Manan banks purse seine catches
- All non-Canadian catches in Div. 4X-4Wb

i.e., catches in New Brunswick weirs and in the New Brunswick winter brit fishery are excluded.

Although substantial removals of 2-yr-olds occur from the stock so defined, quota regulations refer only to adult herring which, for assessment purposes, are considered to imply herring of age 3 and older. Furthermore, the regulations apply only to mobile fishing units, i.e., purse seiners and trawlers, not to fixed gears (weirs and traps) or relatively immobile gears (gillnets).

Thus, in estimating the size of catch quotas (TAC), projected catches of immobile gears and of 2-yr-olds by mobile gears must be deducted from projected total catches.

COHORT ANALYSIS

Numbers removed at age from the S.W. Nova Scotia stock (Table 8) were used in a cohort analysis (Pope 1972) assuming $F = 0.50$ for the last age of year classes fully through the fishery and taking the average F values at age calculated for 1965-1972 as starting F 's for 1973 (Tables 9a and 9b).

The use of average F 's for 1973 is undoubtedly inappropriate as the pattern of F 's changes among years in relation to the strengths of the year classes being fished,

high F's being associated with strong year classes. Thus, the average pattern is not applicable to specific years. Furthermore, the pattern of the fishery in 1973 was unique with closure midway through the fishing season, with the result that the normal fishery on spawning adults in the latter part of the season was prevented. Thus, mortality was probably proportionately higher on juvenile year classes than on adults in 1973 in comparison to earlier years.

However, errors in initial F's predominantly affect the estimates for most recent years, and estimates of F and population numbers for 1969 and earlier will be affected very little by these errors. Thus, it is valid to conclude that the strengths of the 1963-1968 year classes at age 1 were:

<u>Year class</u>	<u>Population at age 1 ($\times 10^{-9}$)</u>
1963	2.7
1964	1.3
1965	1.1
1966	2.4
1967	0.5
1968	0.5

STOCK AND YIELD PREDICTIONS THROUGH 1975

A variety of predictions, some based on historical data and analysis but others based only on "reasonable" assumptions, are required to estimate the 1975 catch which will meet a particular management objective. For this analysis it is assumed that the management objective is to maintain an $F = 0.50$ on age groups 3 and older. This is approximately the value of F predicted to maximize yield-per-recruit (Fig. 1).

Year class strength hypotheses

Firm estimates of the strength of the 1963-1968 year classes were obtained from cohort analysis. However, to predict 1975 catches of age 3+ fish, estimates of the strength of the 1969-1972 year classes are required.

Cohort analysis, assuming F's in 1973 were average for each age group, implies that the 1969 year class was comparable in strength to those of 1967 and 1968. This is sufficiently reliable to categorise the 1969 year class as "poor" rather than "good" (as for example the 1966 year class). The estimate of the 1970 year class as three times the strength of the 1966 year class is likely to be an overestimate as F in 1973 was likely higher on age 3 than the historical average for that year class for the reasons discussed earlier. The low estimates of the size of 1971 and 1972 year classes are essentially meaningless other than they reflect their insignificant performance in the fishery at ages 1 and 2.

Removals by the fishery are themselves some indication of relative year class sizes. There is a moderately good correspondence between catches at age 2 of a year class in New Brunswick weirs with population estimates at age 1 for the S.W. Nova Scotia stock. Without implying stock relationships between populations, but simply using this as an empirical relationship, the following correspondences emerge:

Year Class

	<u>1963</u>	<u>1964</u>	<u>1965</u>	<u>1966</u>	<u>1967</u>	<u>1968</u>	<u>1969</u>	<u>1970</u>	<u>1971</u>
N.B. weir catch at age 2 ($\times 10^{-6}$)	775	139	160	694	351	313	165	615	212
Population at age 1 in S.W. Nova Scotia stock ($\times 10^{-9}$)	2.7	1.3	1.1	2.4	0.5	0.5	-	-	-

The good year classes of 1963 and 1966 contributed strongly to weir catches, whereas the poorer year classes of 1964-1965 and 1967-1968 contributed considerably less. If

this correspondence also holds for the 1969-1971 year classes, those of 1969 and 1971 are comparable in size to the "poor" year classes while that of 1970 is comparable to those of 1963 and 1966.

It is assumed then, that the year classes of 1969 and 1971 are comparable in strength to the 1967 and 1968 year classes, and the 1972 year class, for which there is no evidence to bring to bear, is also assumed to be about the same size. The following sizes at age 1 are assumed:

<u>Year class</u>	<u>No. at age 1</u>
1969	500×10^6
1971	483×10^6
1972	670×10^6

The 1970 year class was the dominant year class in the population in 1973 and formed a major portion of the biomass of the population. Thus, differing assumptions on the strength of the 1970 year class have a major effect on the calculated biomass of the total stock in 1973. Stock biomasses of age 2+ fish in 1966-1971 were calculated from estimated population numbers (Table 9) and mean weight at age, and plotted against purse seine catch per unit effort (from table 7). These independent estimates of population abundance are closely related (Fig. 2). The curve fitted (by eye) in Fig. 2 is not linear as catch/effort declined less than would be predicted from a proportional relationship with biomass, as biomass declined. Catch per unit effort of the Canadian purse seine fleet in 1973 was 49.1 tons per boat night which corresponds to an estimated biomass of 505,000 metric tons.

Taking the assumptions on the 1969, 1971 and 1972 year classes outlined above, and that F on ages 5+ was as used in the cohort analysis (giving an estimate of biomass excluding the 1970 year class of 122,000 tons), various assumptions on the size of the 1970 year class can be tested. Catch/effort in 1973 implies that the 1970 year class is between $2x$ and $2.5x$ the strength of the 1966 year class (Fig. 2) if the cpe-biomass relationship held in 1973.

Other assumptions

The most important hypothesis in this analysis is that concerning the strength of the 1970 year class. In prediction of 1975 catches, three options were used--that it was $1.5x$, $2x$, $2.5x$, the strength of the 1966 year class.

Fishing mortality on ages 5+ in 1973 is of relatively minor importance. Three options were used--that F on the 1966 year class in 1973 was $F = 0.4$, 0.5 , 0.6 and F 's on other year classes were in the same proportion to that on the 1966 year class as was determined for 1972 by cohort analysis.

Mean weights at age of the catches in 1973-1975 were assumed to be the same as for 1973 (Tables 10-18).

The catch quota of 90,000 tons for 1974 will equate to removals of about 105,000 tons from the stock when immobile gear catches are added (assuming catches of age 2 fish will be insignificant as predicted). The age distribution of this catch is assumed to be similar to that in 1973, giving removals at age as shown in Tables 10-18.

F in 1975 is taken as 0.50 for ages 5 and older (previously defined as the management objective), and values of $F = 0.25$ at age 4, $F = 0.13$ at age 3, and $F = 0.03$ at age 2, as would be expected on poor year classes entering the fishery (see Table 10).

Thus, nine options were run on 1975 catches (three options on 1970 year class strength, three on 1973 F on ages 5+) using the above assumptions, and these calculations are presented in Tables 10-18.

CONCLUSIONS

The size of the 1975 TAC is mainly dependent on the strengths assumed for the year classes of 1970-1972, particularly that of 1970. F in 1973 on ages 5+ is considerably less important. A summary of Tables 10-18 is given in Table 19, with corresponding TAC's for the mobile fleet.

If the 1970 year class is twice as good as that of 1966 or greater, a TAC of 90,000 tons can be maintained in 1975. This analysis indicates that the hypothesis that the 1970 year class = $2 \times$ 1966 year class is justified.

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Table 1. Herring catches from 4X and 4Wb, 1940-1973 (metric tons).

<u>Canadian¹</u>	<u>Foreign</u>
1940 - 33,075	1963 - 34
1941 - 50,073	1964 - 663
1942 - 43,753	1965 - 2,964
1943 - 49,913	1966 - 2,472
1944 - 49,378	1967 - 5,928
1945 - 42,864	1968 - 2,417
1946 - 60,347	1969 - 13,405
1947 - 56,750	1970 - 60,952
1948 - 50,919	1971 - 23,939
1949 - 36,361	1972 - 23,612
1950 - 49,821	1973 - 32,541
1951 - 43,324	
1952 - 50,964	
1953 - 32,996	
1954 - 37,890	
1955 - 19,325	
1956 - 33,497	
1957 - 47,602	
1958 - 54,195	
1959 - 70,417	
1960 - 72,952	
1961 - 51,380	
1962 - 62,098	
1963 - 65,122	
1964 - 91,850	
1965 - 126,113	
1966 - 189,611	
1967 - 190,732	
1968 - 229,805	
1969 - 140,944	
1970 - 122,178	
1971 - 67,606	
1972 - 139,589	
1973 - 104,309	

¹Prior to 1963 figures represent total landings, not catches.

Table 2a. Length frequency sampling data, 1965-1973.

Year	New Brunswick Purse Seines		New Brunswick Weirs		Nova Scotia Purse Seines		Nova Scotia Weirs		Nova Scotia Gillnets		Grand Manan Purse Seines		Foreign Purse seines	
	No. of fish samples	No. of fish samples	No. of fish samples	No. of fish samples	No. of fish samples	No. of fish samples	No. of fish samples	No. of fish samples	No. of fish samples	No. of fish samples	No. of fish samples	No. of fish samples	No. of fish samples	No. of fish samples
1965	3,475	16	13,608	77	4,291	26	2,902	17	1,260	12	-	-	-	-
1966	3,041	21	7,753	64	4,451	30	1,707	16	1,246	10	-	-	-	-
1967	4,729	34	7,235	58	5,558	24	3,634	27	1,740	12	-	-	-	-
1968	6,611	43	8,943	72	8,933	33	2,696	19	614	5	-	-	-	-
1969	7,060	43	18,196	108	46,033	196	4,930	21	199	2	-	-	14,027	-
1970	6,612	35	10,554	62	49,374	185	9,166	48	2,500	15	-	-	27,000	-
1971	1,233	9	7,573	45	9,299	53	5,897	28	3,322	24	-	-	2,233	-
1972	-	-	9,434	70	14,640	63	2,407	16	2,118	11	4,267	20	15,050	70
1973	1,608	14	17,344	118	17,261	83	12,705	85	9,789	62	1,148	8	9,665	46

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Table 2b. Age-length sampling data, 1965-1973.

Year	Canadian Fishery		Foreign Fisheries	
	No. of fish samples			
1965	4,730	75	-	-
1966	3,738	73	-	-
1967	5,858	94	-	-
1968	4,841	93	-	-
1969	9,785	109	943	46
1970	11,051	142	627	-
1971	8,889	108	679	7
1972	10,580	111	1,142	18
1973	11,172	263	738	10

Table 3a. Nova Scotia purse seine and midwater trawl catches, 1963-1973.

<u>Month</u>	<u>1963</u>	<u>1964</u>	<u>1965</u>	<u>1966</u>	<u>1967</u>	<u>1968</u>	<u>1969</u>	<u>1970</u>	<u>1971</u>	<u>1972</u>	<u>1973</u>
Jan.	-	-	-	107	47	340	76	-	72	-	-
Feb.	-	-	-	-	-	316	-	100	42	-	-
Mar.	-	-	2,574	2,291	-	1,984	835	24	86	-	-
Apr.	-	-	8	3,726	367	629	35	-	-	1	-
May	45	-	163	757	-	352	3,478	42	27	77	21
June	226	1,332	3,035	10,134	13,552	12,362	16,043	9,395	6,625	2,711	7,940
July	3,787	6,393	17,269	26,919	29,799	39,464	21,522	17,908	9,485	15,037	13,087
Aug.	4,729	8,338	15,438	41,982	44,638	53,719	26,473	23,549	8,552	24,154	16,827
Sept.	5,793	6,672	14,673	24,764	26,627	14,737	9,614	12,022	7,755	14,263	27
Oct.	489	2,105	1,274	1,757	1,783	4,753	762	1,379	1,492	690	456
Nov.	24	54	93	-	307	593	380	3,885	935	2,274	37
Dec.	-	-	-	20	292	297	-	-	-	1,951	-
Totals	15,093	24,894	54,527	11,247	117,382	129,546	79,488	68,304	35,071	61,158	38,395

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Table 3b. Nova Scotia weir catches, 1963-1973.

<u>Month</u>	<u>1963</u>	<u>1964</u>	<u>1965</u>	<u>1966</u>	<u>1967</u>	<u>1968</u>	<u>1969</u>	<u>1970</u>	<u>1971</u>	<u>1972</u>	<u>1973</u>
Jan.	-	-	-	-	-	-	-	-	-	-	-
Feb.	-	-	-	-	-	-	-	-	-	-	-
Mar.	-	-	-	-	-	-	-	12	-	-	-
Apr.	1	-	28	31	2	-	138	29	72	2	-
May	59	-	593	490	482	2,116	3,018	2,037	1,652	435	639
June	1,643	430	3,781	2,342	5,123	4,716	4,507	3,193	2,767	2,450	4,682
July	2,658	5,206	3,641	3,505	4,314	2,796	1,434	3,336	2,002	1,760	1,516
Aug.	553	4,070	2,837	1,272	2,162	803	1,154	2,088	1,390	1,321	280
Sept.	94	2,606	1,071	50	370	480	475	994	195	420	64
Oct.	337	135	70	21	20	1,634	6	29	3	32	-
Nov.	-	6	-	-	2	26	-	-	-	-	-
Dec.	-	5	-	-	-	-	-	-	-	346	-
Totals	5,345	12,458	12,021	7,711	12,475	12,571	10,744	11,706	8,081	6,766	7,181

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Table 3c. Nova Scotia 4X gillnet catches, 1963-1973.

<u>Month</u>	<u>1963</u>	<u>1964</u>	<u>1965</u>	<u>1966</u>	<u>1967</u>	<u>1968</u>	<u>1969</u>	<u>1970</u>	<u>1971</u>	<u>1972</u>	<u>1973</u>
Jan.	-	-	-	-	-	1	2	-	-	-	-
Feb.	-	-	-	-	-	-	(2)	-	-	-	-
Mar.	-	-	-	-	-	-	1	-	-	-	-
Apr.	2 (1)	-	-	5 (3)	2 (1)	5 (2)	10 (10)	55 (55)	33 (33)	31 (31)	-
May	152 (151)	4 (4)	29 (19)	155 (84)	10 (9)	116 (29)	62 (61)	171 (157)	161 (153)	129 (122)	145 (56)
June	528 (211)	1,111 (146)	1,188 (490)	974 (757)	1,129 (887)	252 (176)	682 (649)	1,558 (1,079)	1,033 (915)	1,027 (834)	581 (476)
July	1,612 (767)	2,207 (1,257)	2,693 (1,125)	1,860 (1,319)	2,972 (1,853)	3,805 (3,008)	1,516 (1,120)	2,092 (1,427)	1,771 (1,119)	1,230 (719)	529 (183)
Aug.	2,920 (1,191)	2,354 (1,620)	3,370 (2,074)	2,004 (1,310)	2,815 (1,929)	3,950 (2,663)	2,371 (1,400)	2,306 (1,608)	2,629 (1,755)	1,392 (977)	2,275 (1,883)
Sept.	1,062 (632)	1,510 (754)	920 (357)	1,428 (923)	1,353 (716)	29 (5)	432 (201)	1,008 (664)	814 (609)	1,078 (984)	2,178 (1,856)
Oct.	164 (2)	416 (271)	147 (26)	379 (17)	350 (3)	5 (1)	39 (30)	36 (29)	36 (18)	147 (122)	33 (0)
Nov.	53	1 (1)	16	27	1	-	-	-	5 (5)	-	-
Dec.	-	6	-	-	-	5	-	-	-	1	-
Totals	6,493 (2,955)	7,609 (4,053)	8,363 (4,091)	6,835 (4,413)	8,632 (5,398)	8,168 (5,884)	5,115 (3,474)	7,226 (5,019)	6,482 (4,607)	5,035 (3,789)	5,741 (4,454)

Figures in brackets represent catches from main 4X stock.

Table 3d. Nova Scotia - miscellaneous gear catches, 1963-1973.

<u>Month</u>	<u>1963</u>	<u>1964</u>	<u>1965</u>	<u>1966</u>	<u>1967</u>	<u>1968</u>	<u>1969</u>	<u>1970</u>	<u>1971</u>	<u>1972</u>	<u>1973</u>
Jan.	-	-	-	-	-	-	-	-	-	-	-
Feb.	-	-	-	-	-	-	-	-	-	-	-
Mar.	1	-	-	-	-	-	-	-	-	-	-
Apr.	-	2	-	9	6	5	22	-	5	-	-
May	30	20	34	29	26	25	15	42	40	3	89
June	329	365	381	189	229	26	60	410	147	114	191
July	221	294	-	327	382	136	171	284	98	177	101
Aug.	665	334	1,276	425	416	184	409	911	75	274	125
Sept.	676	384	373	72	137	5	78	145	87	49	203
Oct.	32	85	37	163	127	43	9	11	7	33	30
Nov.	-	-	-	-	-	1	5	-	-	-	4
Dec.	-	-	-	1	-	5	-	-	-	-	-
Totals	1,954	1,484	2,101	1,215	1,323	429	765	1,808	459	650	743

Table 3e. New Brunswick purse seine and midwater trawl catches, 1963-1973.

<u>Month</u>	<u>1963</u>	<u>1964</u>	<u>1965</u>	<u>1966</u>	<u>1967</u>	<u>1968</u>	<u>1969</u>	<u>1970</u>	<u>1971</u>	<u>1972</u>	<u>1973</u>
Jan.	1,038	2,135	2,979	260	5,945	4,009	5,501	1,667	2,265	-	1,109
Feb.	327	2,436	1,567	132	3,117	6,963	1,084	68	57	-	201
Mar.	107	538	1,501	1,946	893	8,695	204	1,058	-	-	457
Apr.	-	-	144	2,657	-	384	-	568	-	-	59
May	-	-	-	-	-	-	-	-	4	-	-
June	-	-	-	-	-	-	-	-	-	-	-
July	-	-	-	-	-	-	-	-	277	-	-
Aug.	-	-	-	-	-	-	-	-	468	-	-
Sept.	204	-	1,089	3,900	-	3,721	5,037	2,545	806	-	-
Oct.	4,338	4,931	4,547	7,761	2,797	10,057	3,671	4,152	752	-	-
Nov.	515	3,778	2,050	3,550	2,986	4,793	2,242	3,156	209	-	-
Dec.	342	2,145	1,878	5,382	5,150	7,324	500	4,080	15	-	-
Totals	6,871	15,973	15,755	25,588	20,888	45,946	18,293	17,294	4,853	-	1,826

Table 3f. New Brunswick weir catches, 1963-1973 (metric tons).

<u>Month</u>	<u>1963</u>	<u>1964</u>	<u>1965</u>	<u>1966</u>	<u>1967</u>	<u>1968</u>	<u>1969</u>	<u>1970</u>	<u>1971</u>	<u>1972</u>	<u>1973</u>
Jan.	22	-	-	-	-	-	-	-	2	-	-
Feb.	8	-	-	-	-	-	-	-	-	-	-
Mar.	10	16	8	-	-	-	-	-	-	-	-
Apr.	156	84	313	19	19	7	128	47	68	-	-
May	699	398	1,931	2,657	312	2,092	787	594	1,080	80	2,444
June	3,485	3,919	5,176	7,911	4,450	2,782	1,746	512	809	2,517	2,439
July	9,698	8,668	8,326	10,594	8,291	8,384	6,927	3,166	3,576	7,308	6,850
Aug.	6,150	8,680	8,529	8,831	7,151	7,632	6,707	3,926	3,207	6,136	6,182
Sept.	4,219	3,943	5,735	4,655	5,488	7,596	5,544	4,543	2,570	8,641	4,463
Oct.	3,485	1,360	1,022	870	2,697	2,874	3,395	2,074	719	6,126	2,512
Nov.	143	269	644	64	1,508	747	412	199	93	1,533	208
Dec.	128	-	-	-	16	-	-	12	15	-	28
Totals	28,203	27,337	31,684	35,601	29,932	32,114	25,646	15,073	12,139	32,341	25,126

Table 3g. New Brunswick miscellaneous gear catches, 1963-1973.

<u>Month</u>	<u>1963</u>	<u>1964</u>	<u>1965</u>	<u>1966</u>	<u>1967</u>	<u>1968</u>	<u>1969</u>	<u>1970</u>	<u>1971</u>	<u>1972</u>	<u>1973</u>
Jan.	102	-	41	-	-	-	-	-	-	-	25
Feb.	1	76	-	-	-	-	189	-	-	5	29
Mar.	-	154	99	-	-	-	20	-	-	5	40
Apr.	9	9	2	-	-	144	-	-	-	57	18
May	176	241	2	1	-	114	-	-	26	5	3
June	8	25	-	-	26	-	15	48	21	13	5
July	115	357	704	-	29	27	1	6	49	10	35
Aug.	40	166	98	22	4	2	17	29	296	20	79
Sept.	450	289	527	-	41	92	163	175	55	294	239
Oct.	261	376	189	35	-	415	362	304	45	155	260
Nov.	1	113	-	97	-	204	74	178	21	130	98
Dec.	-	289	-	49	-	33	52	27	8	10	30
Totals	1,163	2,095	1,662	204	100	1,031	893	767	521	704	861

Table 3h. Grand Manan purse seine fishery, 1972-1973.

<u>Month</u>	<u>1972</u>	<u>1973</u>
Jan.	-	-
Feb.	-	-
Mar.	-	-
Apr.	-	-
May	-	-
June	210	-
July	543	14,706
Aug.	3,837	10,517
Sept.	10,147	-
Oct.	10,264	-
Nov.	7,934	-
Dec.	-	-
Totals	32,935	25,223

Table 3i. Foreign 4W and 4X catch, 1969-1973.

<u>Month</u>	<u>1969</u>	<u>1970</u>	<u>1971</u>	<u>1972</u>	<u>1973</u>
Jan.	8	-	-	-	-
Feb.	85	-	12	16	-
Mar.	2	8,040	2,318	344	197
Apr.	1,260	26,860	12,166	4,113	2,283
May	2,357	15,182	3,732	7,639	4,301
June	100	2,130	1,818	5,868	3,745
July	653	3,562	1,564	3,800	3,639
Aug.	432	1,874	554	551	3,031
Sept.	1,643	2,174	724	493	7,567
Oct.	4,618	572	958	736	6,548
Nov.	2,212	246	93	52	1,066
Dec.	35	312	-	-	254
Totals	13,405	60,952	23,939	23,612	32,541

Table 4a. Herring purse seine-midwater trawl - Nova Scotia, 1965-1973 (number at lengths in thousands).

Length (cm)	1965	1966	1967	1968	1969	1970	1971	1972	1973
7	-	-	-	965	-	-	52	-	-
8	419	-	-	8,360	-	-	34	-	-
9	6,915	57	-	85,183	550	-	482	-	-
10	17,234	1,036	-	155,081	3,391	-	2,264	23	-
11	25,077	1,972	-	100,245	3,962	-	853	56	-
12	27,367	2,177	99	54,641	4,004	37	1,338	65	11
13	38,162	2,986	99	27,530	9,012	34	1,327	203	131
14	34,650	5,344	-	20,771	10,178	391	152	804	405
15	18,187	8,037	66	21,449	5,876	793	87	3,909	398
16	8,836	17,983	3,146	28,644	2,960	1,343	113	10,429	465
17	3,985	31,848	6,898	41,412	932	2,619	130	18,511	486
18	7,053	45,621	4,910	52,169	1,441	7,767	123	23,620	215
19	6,144	50,267	3,197	41,353	7,086	13,834	101	19,792	1,075
20	4,037	43,820	3,616	27,095	8,394	11,274	415	29,730	3,376
21	2,567	39,902	6,652	7,765	22,067	4,015	909	45,748	12,271
22	2,056	29,849	9,489	4,896	39,869	1,071	1,373	48,422	33,327
23	728	9,124	15,835	5,980	49,009	516	1,607	33,263	47,032
24	846	1,879	25,636	8,208	42,532	1,571	2,353	7,819	45,183
25	2,055	650	34,239	14,978	32,537	5,326	3,694	4,705	47,313
26	3,613	584	50,895	28,138	22,595	15,229	9,288	7,600	45,880
27	19,044	7,787	62,228	53,102	16,289	35,849	12,272	10,789	24,510
28	52,824	13,978	41,950	73,060	17,170	57,306	10,811	20,916	5,139
29	66,625	64,388	29,585	75,114	30,782	53,969	17,069	32,913	1,252
30	41,442	110,544	53,746	53,812	42,611	34,357	22,374	32,419	3,061
31	17,985	77,647	97,688	45,093	35,319	27,328	22,401	23,529	5,284
32	16,312	27,954	72,691	48,966	26,051	26,138	17,549	20,343	5,019
33	6,574	12,908	30,115	43,840	22,554	18,371	14,638	14,505	3,596
34	2,830	8,606	11,101	23,972	16,599	11,136	6,929	9,606	3,189
35	862	10,723	5,050	14,657	7,876	5,290	3,436	5,012	1,991
36	386	14,917	1,415	6,812	3,443	1,801	1,058	2,320	879
37	46	12,276	411	1,371	913	377	507	730	298
38	139	7,065	-	984	79	75	124	140	40
39	-	780	99	196	190	11	11	2	-
Totals	435,016	662,723	570,870	1,175,858	486,286	337,841	155,888	427,937	291,842
Mean lengths	22.4	26.2	28.9	20.6	26.3	28.6	29.5	25.1	25.4

Table 4b. Herring weirs - Nova Scotia, 1965-1973 (number at lengths in thousands).

Length (cm)	1965	1966	1967	1968	1969	1970	1971	1972	1973
6	-	-	-	-	-	-	-	-	-
7	-	-	-	-	-	-	-	-	-
8	-	-	-	-	-	-	-	-	-
9	82	-	1	38	-	22	-	-	36
10	684	34	139	479	58	589	7	-	37
11	2,949	201	789	920	154	1,098	54	377	37
12	5,401	372	2,449	6,850	364	1,054	183	939	252
13	3,586	722	2,603	19,453	849	1,455	265	4,160	752
14	2,903	1,220	3,644	38,185	2,481	3,193	272	11,419	2,011
15	2,168	916	2,718	33,587	4,884	4,996	610	18,484	4,995
16	1,654	1,188	2,624	17,231	11,237	7,156	973	21,092	5,637
17	1,023	2,507	2,276	9,937	17,640	8,459	1,232	20,339	4,714
18	765	3,543	1,548	5,400	15,932	9,060	1,062	15,971	3,483
19	905	7,384	2,634	4,566	21,523	4,354	798	8,699	5,747
20	1,332	11,256	4,310	5,607	22,489	1,251	891	5,051	9,068
21	1,371	9,692	3,904	3,327	23,666	865	1,765	874	12,511
22	1,585	5,613	5,701	2,446	17,501	316	3,190	475	11,607
23	1,789	2,930	6,106	2,086	9,256	620	3,307	-	8,891
24	2,278	820	7,428	1,808	4,300	1,479	3,830	56	4,014
25	2,832	924	9,533	2,818	1,092	2,823	3,470	132	1,843
26	3,124	776	9,453	2,398	920	3,595	3,750	345	1,794
27	6,644	971	6,471	3,412	936	4,883	2,899	652	914
28	13,369	2,148	3,447	4,960	1,667	6,146	2,515	1,064	583
29	12,815	5,046	2,258	4,606	1,375	4,892	2,933	2,279	328
30	5,366	6,775	4,341	3,783	1,290	5,049	3,397	2,256	571
31	2,073	2,702	6,011	4,008	915	7,022	3,289	1,321	734
32	2,216	1,240	4,420	5,154	673	4,850	3,833	1,156	991
33	1,320	619	2,075	2,552	572	3,486	2,602	1,296	833
34	1,456	373	461	1,444	274	1,549	1,552	919	1,209
35	526	36	192	422	134	392	444	224	813
36	395	-	193	141	70	81	78	53	376
37	132	-	-	14	12	30	25	53	65
38	88	-	10	-	-	3	-	-	5
Totals	82,845	70,018	97,753	187,646	162,277	91,037	49,255	119,698	84,826
Mean lengths	24.6	23.2	24.2	18.6	20.4	23.5	26.6	18.3	21.6

Table 4c. Herring gillnets - Nova Scotia, 1965-1973 (number at lengths in thousands).

Length (cm)	1965	1966	1967	1968	1969	1970	1971	1972	1973
13	-	-	-	-	-	-	-	-	-
14	-	-	-	-	-	-	-	-	-
15	-	-	-	-	-	-	-	-	-
16	-	-	-	-	-	-	-	-	-
17	-	-	-	-	-	-	-	-	-
18	-	-	-	-	-	-	-	-	-
19	-	-	14	-	-	-	-	-	-
20	-	-	50	-	-	-	-	-	-
21	-	-	122	-	-	-	-	-	-
22	-	-	378	57	-	-	-	-	-
23	-	9	376	-	-	-	-	-	-
24	-	-	172	44	-	-	-	-	-
25	-	-	161	-	-	-	-	-	111
26	-	10	25	29	-	-	-	-	-
27	-	149	184	273	68	61	39	95	-
28	-	903	877	334	289	368	369	408	9
29	-	1,946	2,463	399	720	1,167	1,288	1,878	259
30	-	2,105	3,865	1,254	1,306	1,477	1,431	2,748	1,564
31	-	1,486	2,947	3,312	1,530	1,232	2,513	592	3,973
32	-	2,336	2,270	4,400	3,376	2,346	3,464	645	4,080
33	-	2,537	1,903	3,868	4,253	3,026	3,307	2,698	1,941
34	-	1,847	1,367	2,398	4,472	2,102	2,549	1,677	1,370
35	-	862	599	1,167	1,729	433	1,352	695	1,719
36	-	217	85	535	736	61	368	225	2,150
37	-	103	10	137	243	-	68	83	2,309
38	-	42	-	25	129	-	1	15	1,804
39	-	16	14	41	43	-	-	-	1,804
Totals	14,576	17,891	18,282	18,899	12,279	17,648	17,249	12,988	23,645
Mean lengths	32.1	31.0	32.8	33.3	32.4	32.5	31.7	32.3	30.6

Table 4d. New Brunswick purse seine - midwater trawl, 1965-1973 (number at lengths in thousands).

Length (cm)	<u>1965</u>	<u>1966</u>	<u>1967</u>	<u>1968</u>	<u>1969</u>	<u>1970</u>	<u>1971</u>	<u>1972</u>	<u>1973</u>
6	-	1,130	165	-	-	920	-	-	-
7	-	15,464	577	1,349	-	1,855	2,735	-	-
8	14,914	105,902	12,073	16,092	16,873	32,595	12,230	-	-
9	75,743	215,715	71,077	234,823	46,378	119,930	46,835	2,026	11,934
10	151,442	215,692	147,524	100,941	60,604	182,316	36,609	-	-
11	203,360	94,140	244,231	211,710	60,910	206,685	65,834	-	31,789
12	206,205	46,065	320,239	298,346	47,197	171,608	55,410	-	21,789
13	144,571	26,915	190,814	223,201	20,012	137,126	31,976	-	11,583
14	59,678	15,629	63,632	54,593	9,951	98,516	14,280	-	7,179
15	31,936	12,428	25,598	25,451	8,518	56,510	8,305	-	9,170
16	30,622	16,925	17,987	93,458	17,035	31,553	9,104	-	9,012
17	38,327	39,535	32,447	226,614	35,945	25,106	6,123	-	6,193
18	31,504	54,787	40,194	178,009	51,983	21,218	4,791	-	2,508
19	12,696	37,820	27,436	80,234	50,243	14,064	4,429	-	1,044
20	7,318	32,990	16,348	37,788	27,590	12,377	4,906	-	599
21	3,208	17,600	11,689	62,554	18,380	10,129	4,907	-	722
22	1,723	20,938	8,630	8,890	13,759	4,630	3,251	-	-
23	1,269	15,646	2,670	7,252	7,594	1,482	1,071	-	-
24	634	7,948	4,064	8,815	8,180	333	1,133	-	-
25	-	8,851	3,161	9,377	8,248	110	52	-	-
26	-	9,027	1,804	6,815	7,672	113	338	-	-
27	-	7,350	1,119	4,745	4,296	-	79	-	-
28	419	4,240	-	1,514	2,591	110	26	-	-
29	419	3,094	-	757	740	-	-	-	-
30	1,269	2,600	214	-	272	-	-	-	-
31	-	2,275	-	228	596	110	-	-	-
32	-	770	-	-	-	-	-	-	-
33	-	245	-	-	-	-	-	-	-
34	-	370	-	-	-	-	-	-	-
Totals 1,017,265 1,098,104 1,243,705 1,893,628 526,501 1,128,488 313,436 - 115,554									
Mean lengths 12.8 13.0 13.1 14.5 15.6 12.7 12.5 - 13.3									

Table 4e. New Brunswick herring weirs, 1965-1973 (number at lengths in thousands).

Length (cm)	1965	1966	1967	1968	1969	1970	1971	1972	1973
6	-	-	-	686	187	-	394	-	-
7	26	-	118	686	3,901	6	2,697	185	-
8	1,712	685	1,740	808	4,226	5,066	173	39	594
9	8,873	6,663	9,815	6,850	10,739	20,826	8,187	4,760	4,760
10	19,159	13,623	15,426	12,031	21,092	46,689	25,177	9,225	17,164
11	53,897	17,839	19,629	35,579	22,591	27,245	36,759	11,899	34,976
12	88,886	18,315	36,526	60,657	25,608	18,281	38,883	11,327	11,327
13	122,214	20,581	50,599	85,828	38,440	21,203	33,900	13,028	26,574
14	145,562	32,920	39,321	120,187	48,891	26,489	27,241	23,819	18,341
15	143,330	40,818	24,222	133,083	57,960	23,566	21,138	46,160	21,796
16	99,649	41,845	24,284	102,176	63,686	19,304	18,302	86,198	32,409
17	56,824	52,154	25,448	69,682	63,670	21,061	15,059	104,689	39,172
18	33,468	65,041	19,607	44,989	44,634	24,735	9,673	103,145	23,986
19	16,690	77,736	18,097	26,654	29,390	28,689	8,308	84,657	17,278
20	10,749	75,951	12,677	17,097	18,568	27,979	6,534	57,188	16,150
21	9,846	55,082	13,777	10,682	17,641	12,271	4,600	38,926	26,614
22	10,334	25,336	18,855	7,533	17,312	5,064	2,871	19,842	36,653
23	6,386	14,437	21,313	4,875	10,519	1,308	1,361	7,816	40,675
24	6,734	11,368	24,122	7,338	6,581	620	1,836	3,768	25,960
25	10,563	7,771	23,469	11,724	5,023	1,266	3,407	1,981	18,000
26	12,098	6,771	24,171	12,441	3,146	1,941	5,186	1,840	13,734
27	12,998	9,794	19,990	6,177	1,930	3,134	6,448	2,945	6,365
28	11,628	11,426	11,091	9,270	1,789	4,890	2,784	3,736	1,693
29	6,459	6,836	5,320	6,679	1,596	3,018	1,491	4,702	279
30	2,078	5,078	3,415	4,228	3,462	2,220	1,768	3,214	381
31	2,906	2,703	2,791	2,538	4,665	2,593	2,076	1,863	581
32	392	760	1,153	2,371	5,771	2,086	1,882	875	253
33	96	327	1,138	1,381	4,562	1,758	2,311	802	73
34	170	-	179	614	2,426	1,110	1,275	1,238	104
35	-	-	-	-	380	111	484	321	89
36	-	-	62	-	27	-	103	-	-
37	79	45	-	-	-	-	-	-	-
38	-	-	-	-	-	-	-	-	-
39	-	-	-	-	-	-	34	-	-
Totals	891,821	621,920	468,370	804,169	536,201	349,901	297,253	647,113	424,716
Mean lengths	15.9	18.9	18.7	16.5	17.2	16.3	15.6	18.3	19.0

Table 4f. Foreign 4W-4X purse seine, 1969-1972
(number at lengths in thousands).

Length (cm)	1969	1970	1971	1972
14	-	83	-	-
15	-	41	-	-
16	-	166	-	-
17	-	124	-	-
18	-	83	-	-
19	-	291	-	-
20	3	498	-	-
21	24	956	1,611	-
22	48	1,168	4,265	39
23	137	1,540	6,635	235
24	147	2,984	6,825	396
25	270	5,153	4,645	896
26	424	8,783	2,464	690
27	902	16,327	1,743	1,085
28	2,249	30,647	3,558	2,720
29	3,357	36,640	9,318	5,411
30	9,399	25,579	13,116	8,224
31	10,070	21,140	12,332	8,627
32	7,063	21,354	12,073	9,452
33	3,352	24,737	12,571	11,425
34	3,278	19,253	9,934	11,860
35	2,853	13,335	5,967	9,961
36	1,558	7,676	3,078	6,446
37	680	4,445	1,443	3,034
38	137	1,861	1,027	1,558
39	70	544	375	279
Totals	46,032	245,420	112,988	82,353
Mean lengths	31.8	30.9	30.4	33.0

Table 4g. Grand Manan purse seine - midwater trawl,
1972-1973 (number at lengths in thousands).

Length (cm)	1972	1973
10	674	-
11	3,421	-
12	2,056	-
13	1,365	-
14	674	-
15	1,766	-
16	14,523	-
17	47,774	-
18	53,988	-
19	52,394	-
20	40,756	-
21	38,554	-
22	28,654	908
23	16,686	17,771
24	10,309	57,321
25	5,773	76,013
26	2,003	37,230
27	1,008	9,524
28	1,165	1,836
29	834	-
30	2,260	14.9
31	5,151	-
32	7,784	-
33	10,791	-
34	13,898	-
35	4,676	14.9
36	2,029	-
37	115	-
38	-	-
39	-	-
Totals	371,094	200,904
Mean lengths	21.6	25.3

Table 5a. Nova Scotia purse seine - midwater trawl, 1965-1973 (number at age in thousands).

Age	1	2	3	4	5	6	7	8	9	10
1965	30	190,099	16,690	186,285	34,815	6,270	639	121	-	-
1966	510	43,260	229,588	44,686	278,551	41,612	14,833	7,671	1,627	215
1967	145	24,358	44,315	207,121	99,149	143,100	48,034	4,027	350	-
1968	-	628,560	60,063	56,245	248,381	62,149	74,885	26,276	13,233	4,889
1969	-	26,099	220,167	39,911	95,438	49,242	38,052	12,903	3,020	1,295
1970	183	41,458	6,211	130,845	75,764	45,228	23,545	11,134	2,946	373
1971	4,524	4,624	26,880	26,506	40,440	18,811	23,556	7,092	2,296	635
1972	147	232,313	27,433	66,800	36,900	29,334	14,885	12,531	5,128	1,602
1973	-	2,067	237,703	26,530	6,563	6,790	4,198	2,970	3,374	1,010

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Table 5b. Nova Scotia weir, 1965-1973 (number at age in thousands).

Age	1	2	3	4	5	6	7	8	9	10
1965	-	20,705	9,373	40,352	9,135	1,983	652	241	-	-
1966	106	2,412	39,515	10,080	16,660	1,052	98	34	37	-
1967	4,285	18,873	24,294	30,153	7,560	9,269	2,890	320	59	-
1968	13,852	117,585	18,836	7,623	16,694	4,671	6,083	1,656	555	52
1969	5	39,438	104,153	11,005	4,668	1,738	821	266	96	42
1970	265	41,801	2,904	20,030	10,457	9,956	3,922	1,397	216	49
1971	98	6,464	15,403	8,026	7,829	3,803	5,774	1,434	295	43
1972	411	107,162	964	3,609	2,631	1,970	1,278	1,235	329	61
1973	-	18,438	57,422	2,760	1,138	1,207	974	968	1,306	373

Table 5c. Nova Scotia gillnets, 1965-1973 (number at age in thousands).

<u>Age</u>	<u>1</u>	<u>2</u>	<u>3</u>	<u>4</u>	<u>5</u>	<u>6</u>	<u>7</u>	<u>8</u>	<u>9</u>	<u>10</u>
1965	-	24	9	6,444	5,179	2,468	300	114	16	11
1966	-	6	952	1,297	13,260	2,252	75	11	25	-
1967	-	3	62	1,129	3,077	6,836	7,012	150	-	-
1968	-	-	-	177	2,890	3,363	6,799	3,326	1,489	694
1969	-	-	55	247	2,723	3,975	3,264	1,657	320	31
1970	-	-	16	1,937	3,169	5,008	3,970	2,583	795	143
1971	4	17	1,050	2,856	4,235	2,466	4,359	1,566	492	112
1972	-	2	262	2,501	2,226	2,504	1,903	2,197	979	255
1973	-	-	6,969	4,564	3,328	2,652	2,083	1,510	1,481	601

Table 5d. New Brunswick purse seine-midwater trawl, 1965-1973 (number at age in thousands).

<u>Age</u>	<u>1</u>	<u>2</u>	<u>3</u>	<u>4</u>	<u>5</u>	<u>6</u>	<u>7</u>	<u>8</u>	<u>9</u>	<u>10</u>
1965	237,004	770,483	7,425	2,034	159	-	-	-	-	-
1966	142,761	766,818	161,525	14,411	12,103	410	19	-	-	-
1967	652,631	488,381	75,092	27,075	214	-	-	-	-	-
1968	152,185	1,577,928	132,033	16,758	14,446	228	-	-	-	-
1969	96,152	236,853	179,517	10,649	1,615	1,631	20	-	-	-
1970	618,860	491,144	17,363	774	105	51	24	-	-	-
1971	76,762	226,928	9,259	436	19	14	-	-	-	-
1972	-	-	-	-	-	-	-	-	-	-
1973	-	85,109	30,430	-	-	-	-	-	-	-

Table 5e. New Brunswick weir, 1965-1973 (number at age in thousands).

<u>Age</u>	<u>1</u>	<u>2</u>	<u>3</u>	<u>4</u>	<u>5</u>	<u>6</u>	<u>7</u>	<u>8</u>	<u>9</u>	<u>10</u>
1965	914	775,350	59,699	48,766	6,307	252	106	70	-	-
1966	4,099	138,906	403,165	45,989	28,187	1,334	57	12	21	27
1967	129,716	160,345	55,310	105,564	11,890	4,094	1,106	112	3	-
1968	2,195	694,454	47,712	23,159	29,243	3,649	2,897	697	71	9
1969	61,441	350,729	94,542	4,719	9,222	7,216	6,063	1,904	282	3
1970	3,972	312,870	9,230	11,628	5,571	3,508	2,175	822	56	9
1971	80,935	164,986	33,704	7,327	3,818	2,028	2,858	1,117	309	48
1972	7,573	615,193	6,003	10,094	3,939	1,868	959	1,082	330	31
1973	26,058	197,682	178,602	20,372	1,017	586	92	131	58	4

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Table 5f. Grand Manan purse seine, 1972-1973 (number at age in thousands).

<u>Age</u>	<u>1</u>	<u>2</u>	<u>3</u>	<u>4</u>	<u>5</u>	<u>6</u>	<u>7</u>	<u>8</u>	<u>9</u>	<u>10</u>
1972	7,174	308,493	6,060	5,471	4,169	12,137	9,690	10,944	4,839	1,291
1973	-	-	194,932	5,818	-	-	-	-	-	-

Table 5g. Foreign purse seine, 1969-1973 (number at age in thousands).

<u>Age</u>	<u>1</u>	<u>2</u>	<u>3</u>	<u>4</u>	<u>5</u>	<u>6</u>	<u>7</u>	<u>8</u>	<u>9</u>	<u>10</u>
1969	-	12	682	789	12,921	16,491	6,522	4,011	2,758	1,421
1970	-	545	5,688	35,727	73,686	28,952	62,471	17,732	13,471	6,735
1971	-	-	19,278	8,787	27,688	16,810	19,403	10,939	6,649	3,425
1972	-	-	634	3,509	9,684	10,802	11,228	8,267	8,531	4,572
1973	-	-	149,165	9,132	1,602	160	-	-	-	-

Table 6. Maturity stage distribution in percent by age group for August and September combined, 1971-1973
(sexes combined).

		Maturity stages									
		1	2	3	4	5	6	7	8	9	Total obs.
		-	-	-	-	-	-	-	-	-	-
1971		98.97	1.02	-	-	-	-	-	-	-	98
2		3.56	35.31	26.39	22.55	4.15	8.01	-	-	-	337
3		-	5.65	7.86	33.90	16.95	20.14	0.73	13.51	1.22	407
4		-	-	4.01	27.30	23.69	38.95	1.20	4.41	0.40	249
5		-	-	-	-	-	-	-	-	-	-
		Maturity stages									
		1	2	3	4	5	6	7	8	9	Total obs.
		-	-	-	-	-	-	-	-	-	-
1972		86.84	13.15	-	-	-	-	-	-	-	190
2		6.08	31.08	22.29	18.24	6.08	15.54	0.67	-	-	148
3		0.19	7.92	8.31	25.54	19.40	22.37	-	16.23	-	505
4		-	9.94	4.97	28.17	27.07	15.46	1.10	13.25	-	181
5		-	-	-	-	-	-	-	-	-	-
		Maturity stages									
		1	2	3	4	5	6	7	8	9	Total obs.
		-	-	-	-	-	-	-	-	-	-
1973		100.00	-	0.39	-	0.19	0.19	-	-	-	5
2		78.97	20.23	-	-	-	-	-	-	-	509
3		7.80	41.32	15.40	15.45	10.47	4.31	1.95	3.28	-	1,948
4		0.23	6.23	11.03	27.81	33.81	15.82	1.19	3.83	-	417
5		-	1.93	3.87	27.09	44.51	16.77	3.22	2.58	-	155

Table 7. Monthly and annual catch per unit effort (CUE) for S.W. Nova Scotia purse seine fishery, 1966-1973.

	<u>June</u>	<u>July</u>	<u>Aug.</u>	<u>Sept.</u>	<u>Oct.</u>	<u>Nov.</u>	Mean annual CUE			June, July, Aug. CUE		
							Mean CUE	June	July, Aug. CUE	Mean CUE	June, July, Aug. CUE	Mean CUE
1966	45.3	55.6	69.6	69.2	-	-	60.4	58.4		.967)		
1967	24.4	42.9	66.5	57.0	-	-	55.5	55.2		.995)		
1968	39.8	48.0	59.8	61.7	32.9	-	52.8	52.3		.991)		
1969	27.4	35.1	55.7	54.3	-	-	41.7	39.4		.945)		
1970	31.5	33.7	44.7	43.8	25.5	-	39.0	38.3		.982)		
1971	23.1	34.1	35.2	35.2	23.4	-	32.6	32.2		.988)		
1972	21.8	36.2	47.7	49.2	56.7	65.2	45.0	-		-		
1973 1)	34.4	41.7	63.4	47.7	-	-	49.1 4)	48.0		-		
2)	35.3	44.6	62.8	-	-	-	-	-		-		
3)	33.2	33.8	63.6	47.7	-	-	-	-		-		

- 1) Combined logbook and Fishery Officer reports.
- 2) Fishery Officer reports.
- 3) Logbook reports.
- 4) Weighted annual 1973 mean CUE

$$49.1 = 48.0 \div .978.$$
- 5) Mean of this ratio for period

$$1966-1971 = .978.$$

Table 8. Catches from 4X-4Wb stock (numbers x 10⁻³).

Age	Fishery year	1965		1966		1967		1968		1969		1970		1971		1972		1973	
		1965	1966	1966	1967	1967	1968	1968	1969	1969	1970	1970	1970	1971	1971	1971	1972	1972	1973
1	30	616	4,430	13,852	5	448	4,626	7,732	1										
2	210,828	45,678	43,234	746,145	65,549	83,808	11,105	647,970	20,505										
3	26,072	270,055	68,671	78,899	325,057	14,819	62,611	35,408	650,221										
4	233,081	56,063	238,403	64,045	51,952	188,539	46,175	82,118	57,480										
5	49,129	308,471	109,786	267,965	115,750	163,076	80,192	56,397	21,127										
6	10,721	44,916	159,205	70,183	71,446	89,144	41,890	58,906	17,996										
7	1,591	15,006	57,936	87,767	48,659	93,908	53,092	43,546	16,102										
8	476	7,716	4,497	31,258	18,837	32,846	21,031	39,860	13,155										
9	16	1,689	409	15,277	6,194	13,428	9,732	23,034	11,901										
10	11	215	296	5,635	2,789	7,300	4,215	9,315	5,520										

Table 9a. Population estimates using average F's for 1973 (numbers $\times 10^{-6}$).

<u>Age</u>	<u>1965</u>	<u>1966</u>	<u>1967</u>	<u>1968</u>	<u>1969</u>	<u>1970</u>	<u>1971</u>	<u>1972</u>	<u>1973</u>
1	1,344	1,117	2,434	515	518	503	7,423	187	-
2	2,207	1,101	914	1,989	409	424	411	6,073	146
3	734	1,616	860	709	953	275	271	327	4,386
4	1,219	577	1,079	642	509	486	212	165	235
5	316	788	422	667	468	370	228	132	61
6	79	215	366	246	304	278	155	114	57
7	27	55	135	155	138	184	147	89	40
8	3	21	31	58	48	69	66	72	34

Table 9b. Calculated F values from V.P. analysis.

<u>Age</u>	<u>1965</u>	<u>1966</u>	<u>1967</u>	<u>1968</u>	<u>1969</u>	<u>1970</u>	<u>1971</u>	<u>1972</u>	<u>1973</u>
1	-	-	-	.03	-	-	-	.05	.01
2	.11	.05	.05	.54	.20	.25	.03	.13	.17
3	.04	.20	.09	.13	.47	.06	.29	.13	.18
4	.24	.11	.28	.12	.12	.56	.28	.80	.31
5	.19	.57	.34	.59	.32	.67	.49	.64	.48
6	.16	.26	.66	.38	.30	.44	.35	.85	.43
7	.07	.36	.64	.98	.49	.83	.51	.78	.58
8	.17	.53	.17	.90	.57	.75	.44	.94	.56
\bar{F}_{5+}	.19	.43	.45	.71	.42	.67	.45	.80	.51

Table 10.

NATURAL MORTALITY 0.2000 1966 K.C. F=0.4

AGE 1973	POP. NO. (X10-3)	CATCH NO. (X10-3)	FISHING MORT.	MEAN WT.	POP. WT. (METRIC TONS)	CATCH WT. (METRIC TONS)	RESIDUAL POP. NOS.
2	388100.	20505.	0.060	0.031	12031.1	635.6	298946.0
3	1822499.	650221.	0.495	0.114	207764.8	74125.1	908653.5
4	236702.	57480.	0.310	0.159	37635.6	9139.3	141996.4
5	74079.	21127.	0.375	0.227	16815.9	4795.8	41642.9
6	76009.	17996.	0.301	0.270	20522.4	4858.9	46009.6
7	53531.	16102.	0.400	0.299	16005.7	4814.4	29349.0
8	47176.	13133.	0.365	0.334	13726.7	4393.7	26786.1
9	36486.	11901.	0.442	0.360	13134.9	4284.3	19181.1
10	7728.	5520.	1.468	0.386	2983.0	2130.7	1456.2
TOTAL	2742310.	814907.			342650.4	109178.2	1514021.3
AGE 1974	POP. NO. (X10-3)	CATCH NO. (X10-3)	FISHING MORT.	MEAN WT.	POP. WT. (METRIC TONS)	CATCH WT. (METRIC TONS)	RESIDUAL POP. NOS.
2	548000.	14800.	0.030	0.031	16988.0	458.7	434969.2
3	293945.	16900.	0.036	0.114	34079.8	1687.1	231195.3
4	908653.	470580.	0.829	0.159	144475.9	74822.2	324395.7
5	141996.	41640.	0.387	0.227	32233.1	9452.2	78770.0
6	41642.	15300.	0.514	0.270	11243.5	4131.0	20371.4
7	46009.	13020.	0.371	0.299	13756.8	3892.9	23967.6
8	29349.	11640.	0.568	0.334	9802.5	3887.7	13602.6
9	26786.	9540.	0.493	0.360	9643.0	9434.3	13981.6
10	19181.	8640.	0.676	0.386	7403.9	3335.0	7979.9
TOTAL	2060565.	599960.			279626.9	105101.6	1150733.6
AGE 1975	POP. NO. (X10-3)	CATCH NO. (X10-3)	FISHING MORT.	MEAN WT.	POP. WT. (METRIC TONS)	CATCH WT. (METRIC TONS)	RESIDUAL POP. NOS.
2	548000.	14686.	0.030	0.031	16988.0	455.2	435404.4
3	434969.	48162.	0.130	0.114	49586.4	5490.5	312709.7
4	231195.	46543.	0.250	0.159	36760.0	7400.4	147476.6
5	324395.	116646.	0.500	0.227	73637.8	26478.8	161090.1
6	78870.	28360.	0.500	0.270	21294.9	7657.2	39165.7
7	20371.	7325.	0.500	0.299	6091.0	2190.2	10116.1
8	23967.	9337.	0.500	0.334	8673.1	9118.7	12692.1
9	13602.	4891.	0.500	0.360	4896.9	1760.8	6754.8
10	13381.	4811.	0.500	0.386	5165.3	1857.3	6645.1
TOTAL	1690753.	280765.			223093.8	56409.5	1132197.9

Table 11.

NATURAL MORTALITY = 0.2000 1966 F.C. F=0.5 1970 F.C. = 1.5 X 1966 F.C.

AGE 1973	POP. NO. (X10-3)	CATCH NO. (X10-3)	FISHING MORT.	MEAN WT. (METRIC TONS)	POP. WT. (METRIC TONS)	CATCH WT. (METRIC TONS)	RESIDUAL POP. NOS.
2	388100.	20505.	0.060	0.031	12031.1	635.6	298946.0
3	1622499.	650221.	0.495	0.114	207764.8	74125.1	908653.5
4	236702.	57480.	0.310	0.159	37635.6	9139.3	141996.4
5	61678.	21127.	0.470	0.227	14000.9	4795.8	31529.6
6	66846.	1796.	0.350	0.270	18048.4	4858.9	38528.2
7	44779.	16102.	0.500	0.299	13288.9	4814.4	22214.3
8	29726.	13135.	0.450	0.334	13278.5	4393.7	20733.7
9	30757.	11901.	0.550	0.360	11072.5	4284.3	14514.0
10	7728.	5520.	1.468	0.386	2983.0	2130.7	1426.2
TOTAL	2698845.	814007.			330203.8	109178.2	1478572.2
AGE 1974	POP. NO. (X10-3)	CATCH NO. (X10-3)	FISHING MORT.	MEAN WT. (METRIC TONS)	POP. WT. (METRIC TONS)	CATCH WT. (METRIC TONS)	RESIDUAL POP. NOS.
2	548000.	14800.	0.030	0.031	16988.0	458.7	434969.2
3	298946.	14800.	0.056	0.114	34079.8	1687.1	231195.3
4	908653.	47058.	0.829	0.159	144475.9	74822.2	324395.7
5	141996.	41640.	0.387	0.227	32233.6	9452.2	78870.0
6	31529.	15300.	0.752	0.270	8512.9	4131.0	12157.2
7	38528.	13020.	0.462	0.299	11519.9	3892.9	19853.7
8	22214.	11640.	0.844	0.334	7419.5	3887.7	7812.6
9	20733.	9540.	0.696	0.360	7464.1	3434.3	8455.0
10	14514.	8640.	1.037	0.386	5602.4	3335.0	4208.5
TOTAL	2025116.	59996.			268296.0	105101.6	1121917.5
AGE 1975	POP. NO. (X10-3)	CATCH NO. (X10-3)	FISHING MORT.	MEAN WT. (METRIC TONS)	POP. WT. (METRIC TONS)	CATCH WT. (METRIC TONS)	RESIDUAL POP. NOS.
2	548000.	14686.	0.030	0.031	16988.0	455.2	435404.4
3	434969.	48162.	0.130	0.114	49586.4	5490.5	312709.7
4	231195.	46543.	0.250	0.159	36760.0	7400.4	147416.6
5	324395.	116646.	0.500	0.227	73637.8	26478.8	161090.1
6	78870.	28360.	0.500	0.270	21294.9	7657.2	39165.7
7	12157.	4371.	0.500	0.299	3635.0	1307.0	6037.1
8	19853.	7139.	0.500	0.334	6631.1	2384.4	9859.0
9	7812.	2809.	0.500	0.360	2812.5	1011.3	3879.6
10	8455.	3040.	0.500	0.386	3263.6	1173.3	4198.6
TOTAL	1665708.	271760.			214609.6	53358.8	1119761.1

Table 12.

NATURAL MORTALITY = 7.2000 1966 FC F=0.6 1970 FC = 1966 FC + 1.5

AGE 1973	POP. NO. (X10-3)	CATCH NO. (X10-3)	FISHING MORT.	MEAN WT. (METRIC TONS)	POP. WT. (METRIC TONS)	CATCH WT. (METRIC TONS)	RESIDUAL POP. NOS.
2	388100.	20505.	0.060	0.031	12031.1	635.6	298946.0
3	1822499.	650221.	0.495	0.114	207764.8	74125.1	908653.5
4	236702.	57480.	0.310	0.159	37635.6	9139.3	141996.4
5	53716.	21127.	0.562	0.227	12193.5	4795.8	25045.9
6	54194.	17996.	0.452	0.270	14632.3	4858.9	28207.0
7	38978.	16102.	0.600	0.299	11654.4	4814.4	17496.4
8	34097.	13155.	0.548	0.334	11386.7	4393.7	16120.0
9	26796.	11901.	0.663	0.360	9646.5	4284.3	11293.7
10	7728.	5520.	1.468	0.386	2983.7	2130.7	1436.2
TOTAL	2662805.	814907.	—	—	319928.2	109178.2	1449215.4

AGE 1974	POP. NO. (X10-3)	CATCH NO. (X10-3)	FISHING MORT.	MEAN WT. (METRIC TONS)	POP. WT. (METRIC TONS)	CATCH WT. (METRIC TONS)	RESIDUAL POP. NOS.
2	548000.	14800.	0.030	0.031	16988.0	458.7	434969.2
3	298946.	14800.	0.056	0.114	34079.8	1687.1	231193.3
4	908653.	470580.	0.829	0.159	144475.9	74822.2	324395.7
5	141996.	41640.	0.387	0.227	32233.1	9452.2	78870.0
6	25045.	15300.	1.085	0.270	6762.3	4131.0	6922.0
7	28207.	13020.	0.700	0.299	8433.8	3892.9	11456.6
8	17496.	11640.	1.269	0.334	5843.8	3887.7	4022.8
9	16120.	9540.	1.027	0.360	5803.2	3434.3	4721.1
10	11293.	8640.	1.722	0.386	4359.4	3335.0	1650.7
TOTAL	1995759.	599960.	—	—	258979.6	105101.6	1098203.9

AGE 1975	POP. NO. (X10-3)	CATCH NO. (X10-3)	FISHING MORT.	MEAN WT. (METRIC TONS)	POP. WT. (METRIC TONS)	CATCH WT. (METRIC TONS)	RESIDUAL POP. NOS.
2	348000.	14686.	0.030	0.031	16988.0	455.2	435404.4
3	434969.	48162.	0.130	0.114	49586.4	5490.5	312709.7
4	231195.	46543.	0.250	0.159	36760.0	7409.4	147416.6
5	324395.	116646.	0.500	0.227	73637.8	26478.8	161090.1
6	78870.	28360.	0.500	0.270	21294.9	7637.2	39163.7
7	6922.	2489.	0.500	0.299	2069.6	744.2	3437.3
8	11456.	4119.	0.500	0.334	3826.5	1375.9	5689.2
9	4022.	1446.	0.500	0.360	1448.2	520.7	1997.7
10	4721.	1697.	0.500	0.386	1822.3	655.2	2344.4
TOTAL	1644553.	764152.	—	—	207434.1	50778.6	1109255.4

Table 13.

NATURAL MORTALITY= 0.2000			1966 KC. F=0.4			1968 KC. = 2.0 X 1966 KC.		
AGE 1973	POP. NO. (X10-3)	CATCH NO. (X10-3)	FISHING MORT.	MEAN WT. (METRIC TONS)	POP. WT. (METRIC TONS)	CATCH WT. (METRIC TONS)	RESIDUAL POP. NOS.	
2	388190•	20505•	0.060	0.031	12031•1	635•6	298946•0	
3	2626844•	650221•	0.317	0.114	299460•2	74125•1	1564839•3	
4	236702•	37480•	0.310	0.159	37635•6	9139•3	141976•4	
5	74079•	21127•	0.375	0.227	16815•9	4795•8	41642•9	
6	76009•	17996•	0.301	0.270	20522•4	4858•9	46009•6	
7	53531•	16102•	0.400	0.299	16005•7	4814•4	29349•0	
8	47176•	13155•	0.365	0.334	15756•7	4393•7	26786•1	
9	36486•	11901•	0.442	0.360	13134•9	4284•3	19181•1	
10	7728•	5520•	1.468	0.386	2983•0	2130•7	1456•2	
TOTAL	3546555•	814007•			434345•8	109178•2	2170207•0	
AGE 1974	POP. NO. (X10-3)	CATCH NO. (X10-3)	FISHING MORT.	MEAN WT. (METRIC TONS)	POP. WT. (METRIC TONS)	CATCH WT. (METRIC TONS)	RESIDUAL POP. NOS.	
2	548000•	14800•	0.030	0.031	16988•0	458•7	434969•2	
3	298946•	14800•	0.056	0.114	34079•8	1687•1	231195•3	
4	1564839•	470580•	0.399	0.159	248809•4	74822•2	858802•0	
5	141996•	41640•	0.387	0.227	32233•1	9452•2	78870•0	
6	41642•	15300•	0.514	0.270	11243•5	4131•0	20371•4	
7	46009•	13020•	0.371	0.299	13756•8	3892•9	25967•6	
8	29349•	11640•	0.568	0.334	9802•5	3887•7	13602•6	
9	26786•	9540•	0.493	0.360	9643•0	3434•3	13381•6	
10	19181•	8640•	0.676	0.386	7403•9	3335•0	7979•9	
TOTAL	2716750•	599960•			383960•5	105101•6	1685139•9	
AGE 1975	POP. NO. (X10-3)	CATCH NO. (X10-3)	FISHING MORT.	MEAN WT. (METRIC TONS)	POP. WT. (METRIC TONS)	CATCH WT. (METRIC TONS)	RESIDUAL POP. NOS.	
2	548000•	14686•	0.030	0.031	16988•0	453•2	435404•4	
3	434969•	48162•	0.130	0.114	49586•4	5490•5	312709•7	
4	231195•	46543•	0.250	0.159	36760•0	7400•4	147415•6	
5	858802•	308809•	0.500	0.227	194948•0	7009•8	426468•4	
6	78870•	28360•	0.500	0.270	21294•9	7657•2	39165•7	
7	20371•	7325•	0.500	0.299	6091•0	2190•2	10116•1	
8	25967•	9337•	0.500	0.334	8673•1	3118•7	12895•1	
9	13602•	4891•	0.500	0.360	4896•9	1760•8	6754•8	
10	13381•	4811•	0.500	0.386	5165•3	1857•3	6645•1	
TOTAL	2225163•	472928•			344404•0	100030•5	1397576•2	

Table 14.

NATURAL MORTALITY = 0.2000 1966 KC. F = 0.5 1970 KC. = 2.0 + 1966 KC.

AGE	POP. NO.	CATCH NO.	FISHING MORT.	MEAN WT.	POP. WT.	CATCH WT.	RESIDUAL
1973	(X10-3)	(X10-3)			(METRIC TONST)	(METRIC TONST)	POP. NOS.
2	3881000.	20505.	0.080	0.031	12031.1	635.6	298946.0
3	2626844.	650221.	0.317	0.114	29460.2	74125.1	1564839.3
4	236702.	57480.	0.310	0.159	37635.6	9139.3	141996.4
5	61678.	21127.	0.470	0.227	14000.9	4795.8	31529.6
6	66846.	17996.	0.350	0.270	18048.4	4858.9	318528.2
7	44779.	16102.	0.500	0.299	13388.9	4814.4	22214.3
8	39755.	13155.	0.450	0.334	13278.5	4393.7	20733.7
9	30757.	11901.	0.550	0.360	11072.5	4284.3	14514.0
10	7728.	5520.	1.468	0.386	2983.0	2130.7	1456.2
TOTAL	3503190.	814007.	—	—	421899.2	109178.2	2134757.9
AGE	POP. NO.	CATCH NO.	FISHING MORT.	MEAN WT.	POP. WT.	CATCH WT.	RESIDUAL
1974	(X10-3)	(X10-3)			(METRIC TONS)	(METRIC TONS)	POP. NOS.
2	548000.	14800.	0.030	0.031	16988.0	458.7	434969.2
3	298946.	14800.	0.036	0.114	34079.8	1687.1	231195.3
4	1564839.	470580.	0.399	0.159	248809.4	74822.2	858802.0
5	141996.	41640.	0.387	0.227	32233.1	9432.2	78870.0
6	31529.	15300.	0.752	0.270	8512.9	4131.0	12157.2
7	38328.	13020.	0.462	0.299	11519.9	3892.9	19853.7
8	22214.	11640.	0.844	0.334	7419.5	3887.7	7812.6
9	20733.	9540.	0.696	0.360	7464.1	3434.3	8425.0
10	14514.	8640.	1.037	0.386	5602.4	3335.0	4208.5
TOTAL	2681301.	599960.	—	—	372629.5	105101.6	1656323.8
AGE	POP. NO.	CATCH NO.	FISHING MORT.	MEAN WT.	POP. WT.	CATCH WT.	RESIDUAL
1975	(X10-3)	(X10-3)			(METRIC TONST)	(METRIC TONST)	POP. NOS.
2	549000.	14686.	0.030	0.031	16988.0	452.2	435404.4
3	434969.	48162.	0.130	0.114	49586.4	5490.5	312709.7
4	231195.	46543.	0.250	0.159	3676.0	7400.7	147416.6
5	858802.	308809.	0.500	0.227	194948.0	70099.8	426468.4
6	78870.	28360.	0.500	0.270	21294.9	6377.2	39165.7
7	12157.	4371.	0.500	0.299	3635.0	1307.0	6037.1
8	19853.	7139.	0.500	0.334	6631.1	2384.4	9859.0
9	7812.	2809.	0.500	0.360	2812.5	1011.3	3879.6
10	8455.	3040.	0.500	0.386	3263.6	1173.5	4198.6
TOTAL	2700115.	463973.	—	—	335919.8	96979.7	1385139.4

Table 15.

NATURAL MORTALITY		0.2000	1966 X.C. F = 0.6	1970 X.C. = 2.0 X 1966 X.C.		
AGE	POP. NO.	CATCH NO.	FISHING MORT.	MEAN WT.	POP. WT.	CATCH WT.
1973	(X10-3)	(X10-3)		(METRIC TONS)	(METRIC TONS)	(METRIC TONS)
2	388100.	20505.	0.060	0.031	12031.1	632.6
3	650221.	650221.	0.317	0.114	299460.2	74125.1
4	236702.	97480.	0.310	0.159	37635.6	9139.3
5	53716.	21127.	0.562	0.227	12193.5	4795.8
6	54194.	17996.	0.452	0.270	14632.3	4828.9
7	38987.	16102.	0.600	0.299	11657.1	4814.4
8	34092.	13155.	0.548	0.334	11386.7	4393.7
9	26796.	11901.	0.663	0.360	9646.5	4284.3
10	7728.	5520.	1.468	0.386	2983.0	2130.7
TOTAL	3467156.	814007.	—	—	211626.2	109178.2
						2105405.2
AGE	POP. NO.	CATCH NO.	FISHING MORT.	MEAN WT.	POP. WT.	CATCH WT.
1974	(X10-3)	(X10-3)		(METRIC TONS)	(METRIC TONS)	(METRIC TONS)
2	548000.	14800.	0.030	0.031	16988.0	458.7
3	298946.	14800.	0.056	0.114	34079.8	1687.1
4	1564839.	470580.	0.399	0.159	248809.4	74822.2
5	141996.	41640.	0.387	0.227	322233.1	9452.2
6	25045.	15300.	1.085	0.270	6762.3	4131.0
7	28207.	13020.	0.700	0.299	8433.8	3892.9
8	17500.	11640.	1.269	0.334	5845.1	3887.7
9	16120.	9540.	1.027	0.360	5803.2	3434.3
10	11293.	8640.	1.722	0.386	4359.4	3335.0
TOTAL	2651948.	599960.	—	—	363314.5	105101.6
						1632611.1
AGE	POP. NO.	CATCH NO.	FISHING MORT.	MEAN WT.	POP. WT.	CATCH WT.
1975	(X10-3)	(X10-3)		(METRIC TONS)	(METRIC TONS)	(METRIC TONS)
2	548000.	14686.	0.030	0.031	16988.0	455.2
3	434969.	48162.	0.130	0.114	49586.4	5490.5
4	231195.	46543.	0.250	0.159	36760.0	7400.4
5	858802.	308809.	0.500	0.227	194948.0	70099.8
6	78870.	28360.	0.500	0.270	21294.9	7657.2
7	6922.	2489.	0.500	0.299	2069.6	744.2
8	11456.	4119.	0.500	0.334	3826.5	1375.9
9	4023.	1446.	0.500	0.360	1448.5	520.8
10	4721.	1697.	0.500	0.386	1822.3	655.2
TOTAL	2178950.	456316.	—	—	328744.7	94399.7
						1374634.2

Table 16.
NATURAL MORTALITY - 0.2000

1966-67. F=0.4
1967-68. F=0.4
1968-69. F=0.4
1969-70. F=0.4

AGE	POP. NO.	CATCH NO.	FISHING WT.	MEAN WT.	POP. WT.	CATCH WT.	RESIDUAL POP. NOS.
	(X10-3)	(X10-3)	MORT.	(METRIC TONS)	(METRIC TONS)	(METRIC TONS)	POP. NOS.
2	388100.	20505.	0.060	0.031	12031.1	635.6	298946.0
3	351900.	650721.	0.727	0.114	401166.0	7425.1	2793724.3
4	236702.	57480.	0.310	0.159	37635.6	9139.3	141996.4
5	74079.	21127.	0.375	0.227	16815.9	4795.8	41642.9
6	76009.	17996.	0.301	0.270	20522.4	4858.9	46009.6
7	53331.	16102.	0.400	0.299	16005.7	4814.6	29349.0
8	47176.	13155.	0.365	0.334	15756.7	4393.7	26786.1
9	36486.	11901.	0.442	0.360	13134.9	4284.3	19181.1
10	7728.	5520.	1.468	0.386	2983.0	2130.7	1456.2
TOTAL	4438811.	814007.			536051.6	109178.2	2899092.0
AGE	POP. NO.	CATCH NO.	FISHING WT.	MEAN WT.	POP. WT.	CATCH WT.	RESIDUAL POP. NOS.
1974	(X10-3)	(X10-3)	MORT.	(METRIC TONS)	(METRIC TONS)	(METRIC TONS)	POP. NOS.
2	548000.	14800.	0.030	0.031	16988.0	438.7	434969.2
3	298946.	14800.	0.056	0.114	34079.8	1687.1	231195.3
4	2293724.	470580.	0.255	0.159	364702.1	74822.2	1453794.2
5	141996.	41640.	0.387	0.227	32233.1	9452.2	78870.0
6	41642.	15300.	0.514	0.270	11243.3	4131.0	20371.4
7	4609.	13020.	0.371	0.299	13756.8	3892.9	25967.6
8	29349.	11640.	0.568	0.334	9802.5	3887.7	13602.6
9	26786.	9540.	0.493	0.360	9643.0	3434.3	13381.6
10	19181.	8640.	0.676	0.386	7403.9	3335.0	7979.9
TOTAL	3449635.	999960.			499853.2	105101.6	2280132.1
AGE	POP. NO.	CATCH NO.	FISHING WT.	MEAN WT.	POP. WT.	CATCH WT.	RESIDUAL POP. NOS.
1975	(X10-3)	(X10-3)	MORT.	(METRIC TONS)	(METRIC TONS)	(METRIC TONS)	POP. NOS.
2	548000.	14686.	0.030	0.031	16988.0	455.2	435404.4
3	434969.	48162.	0.130	0.114	49286.4	9490.5	312709.7
4	231195.	46543.	0.250	0.159	36760.0	7490.4	147416.6
5	1453794.	522758.	0.500	0.227	330011.2	118666.0	721932.8
6	78870.	28360.	0.500	0.270	21294.9	7657.2	39165.7
7	20371.	7325.	0.500	0.299	6091.0	2190.2	10116.1
8	25967.	9337.	0.500	0.334	8673.1	3118.7	12895.1
9	13602.	4891.	0.300	0.360	4896.9	1760.8	6754.8
10	13381.	4811.	0.500	0.386	5165.3	1857.3	6645.1
TOTAL	2820152.	696877.			479467.2	148526.8	1693040.6

Table 17. NATURAL MORTALITY 0-2000 1966-67. F=0.5 1970-71. F=2.5

AGE	POP. NO. (X10-3)	CATCH NO. (X10-3)	FISHING MORT.	MEAN WT.	POP. WT. (METRIC TONS)	CATCH WT. (METRIC TONS)	RESIDUAL POP. NOS.
1973	388100.	20505.	0.660	0.031	12031.1	635.6	298946.0
2	3519000.	650221.	0.227	0.114	401166.0	74125.1	22293724.3
3	236702.	57480.	0.310	0.159	37635.6	9139.3	141996.4
4	61678.	21127.	0.470	0.227	14000.9	4795.8	31529.6
5	66846.	17996.	0.350	0.270	18048.4	4858.9	38528.2
6	42779.	16102.	0.500	0.299	13388.9	4814.9	22214.3
7	39756.	13155.	0.450	0.334	13278.5	4393.7	20733.7
8	31757.	11901.	0.550	0.350	11072.5	4284.3	14514.0
9	7728.	5520.	1.468	0.386	2983.0	2130.7	1456.2
TOTAL	4395346.	814007.			523604.9	109178.2	2863643.0
AGE	POP. NO. (X10-3)	CATCH NO. (X10-3)	FISHING MORT.	MEAN WT.	POP. WT. (METRIC TONS)	CATCH WT. (METRIC TONS)	RESIDUAL POP. NOS.
1974	548000.	14800.	0.930	0.031	16988.0	458.7	434969.2
2	29946.	14800.	0.056	0.114	34079.8	1687.1	231195.3
3	2293724.	47058.	0.255	0.159	364702.1	74822.2	1453794.2
4	141996.	41640.	0.387	0.227	32233.1	9452.2	78870.0
5	31329.	12300.	0.752	0.270	8512.9	4131.0	12137.2
6	38528.	13020.	0.462	0.299	11519.9	3892.9	19853.7
7	22214.	11640.	0.844	0.334	7419.5	3887.7	7812.6
8	20733.	9540.	0.696	0.360	7464.1	3434.3	8455.0
9	14514.	8640.	1.037	0.386	5602.4	3335.0	4208.5
TOTAL	3410186.	399960.			488522.3	105101.6	2235351.1
AGE	POP. NO. (X10-3)	CATCH NO. (X10-3)	FISHING MORT.	MEAN WT.	POP. WT. (METRIC TONS)	CATCH WT. (METRIC TONS)	RESIDUAL POP. NOS.
1975	548000.	14686.	0.030	0.031	16988.0	455.2	435404.4
2	434969.	48152.	0.130	0.114	49586.4	5490.5	312709.7
3	231195.	46543.	0.250	0.159	36760.0	7400.4	147416.6
4	1453794.	522758.	0.300	0.227	330001.2	118666.0	721932.8
5	78870.	28360.	0.500	0.270	21294.9	7657.2	39165.7
6	12137.	4371.	0.500	0.299	3639.9	1307.0	6037.1
7	19853.	7139.	0.500	0.334	6631.1	2384.4	9859.0
8	7812.	2809.	0.500	0.380	2812.5	1011.3	3879.6
9	8455.	3040.	0.500	0.386	3263.6	1173.5	4198.6
TOTAL	2795107.	677871.			470983.1	145546.0	1690603.8

Table 18.

NATURAL MORTALITY 0.2000 1936-40-6-1946-5

AGE 1973	POP. NO. (X10-3)	CATCH NO. (X10-3)	FISHING MORT.	MEAN WT.	POP. WT. (METRIC TONS)	CATCH WT. (METRIC TONS)	RESIDUAL POP. NOS.
2	388100.	20505.	0.060	0.031	12031.1	635.6	298946.0
3	3519000.	650221.	0.27	0.114	401166.0	74125.1	2293724.3
4	236702.	57480.	0.310	0.159	37635.6	9139.3	141996.4
5	53716.	21127.	0.562	0.227	12193.5	4793.8	25045.9
6	54194.	17996.	0.452	0.270	14632.3	4858.9	28207.0
7	38987.	16102.	0.600	0.299	11657.1	4814.4	17500.4
8	34092.	13155.	0.548	0.334	11386.7	4393.7	16120.0
9	26796.	11901.	0.653	0.360	9646.5	4284.3	11293.7
10	7728.	5520.	1.468	0.386	2983.0	2130.7	1456.2
TOTAL	4359315.	814007.			513332.0	109178.2	2834290.2
AGE 1974	POP. NO. (X10-3)	CATCH NO. (X10-3)	FISHING MORT.	MEAN WT.	POP. WT. (METRIC TONS)	CATCH WT. (METRIC TONS)	RESIDUAL POP. NOS.
2	548000.	14800.	0.30	0.031	16988.0	458.7	434969.2
3	298946.	14800.	0.056	0.114	34079.8	1687.1	231195.3
4	2293724.	470580.	0.295	0.159	364702.1	74822.2	1453794.2
5	141996.	41640.	0.387	0.227	32233.1	9452.2	78870.0
6	25045.	13300.	1.083	0.270	6762.3	4137.0	6922.0
7	28207.	13020.	0.700	0.299	8433.8	3892.9	11456.6
8	17500.	11640.	1.269	0.334	5845.1	3887.7	4023.8
9	16120.	9540.	1.027	0.360	5803.2	3434.3	4721.1
10	11293.	8640.	1.722	0.386	4359.4	3335.0	1650.7
TOTAL	3380834.	5999760.			479207.2	105101.6	2277603.4
AGE 1975	POP. NO. (X10-3)	CATCH NO. (X10-3)	FISHING MORT.	MEAN WT.	POP. WT. (METRIC TONS)	CATCH WT. (METRIC TONS)	RESIDUAL POP. NOS.
2	548000.	14686.	0.030	0.031	16988.0	455.2	435404.4
3	434969.	48162.	0.130	0.114	49506.4	3490.5	312709.7
4	231195.	46543.	0.250	0.159	36760.0	7400.4	147416.6
5	-1453794.	222758.	0.500	0.227	336011.2	116666.0	721932.8
6	78870.	28360.	0.500	0.270	21294.9	7657.2	39165.7
7	6922.	2489.	0.500	0.299	2069.6	744.2	3497.3
8	11456.	4119.	0.500	0.334	3826.5	1375.9	56889.2
9	4023.	1446.	0.500	0.360	1448.2	920.8	1998.1
10	4721.	1697.	0.500	0.386	1822.3	655.2	2344.4
TOTAL	2773952.	670264.			463807.9	142966.0	1670098.6

Table 19. Div. 4X-Wb herring — removals (metric tons) in 1975 under varying assumptions of the strength of the 1970 year class and of mortality (F) in 1973 on ages 5 and older. TAC from 3+ fish by mobile gear given in parentheses, assuming 13,000, 15,000, 17,000 tons removed by immobile gears (and no age 2's removed by mobile gear) with increased strength of 1970 y.c.

1973 F on ages 5+	Strength of 1970 year class		
	1970 = 1.5×1966	1970 = 2.0×1966	1970 = 2.5×1966
0.40	56,500 (43,500)	100,000 (85,000)	148,500 (131,500)
0.50	53,500 (40,500)	97,000 (82,000)	145,500 (128,500)
0.60	51,000 (38,000)	94,500 (79,500)	143,000 (126,000)

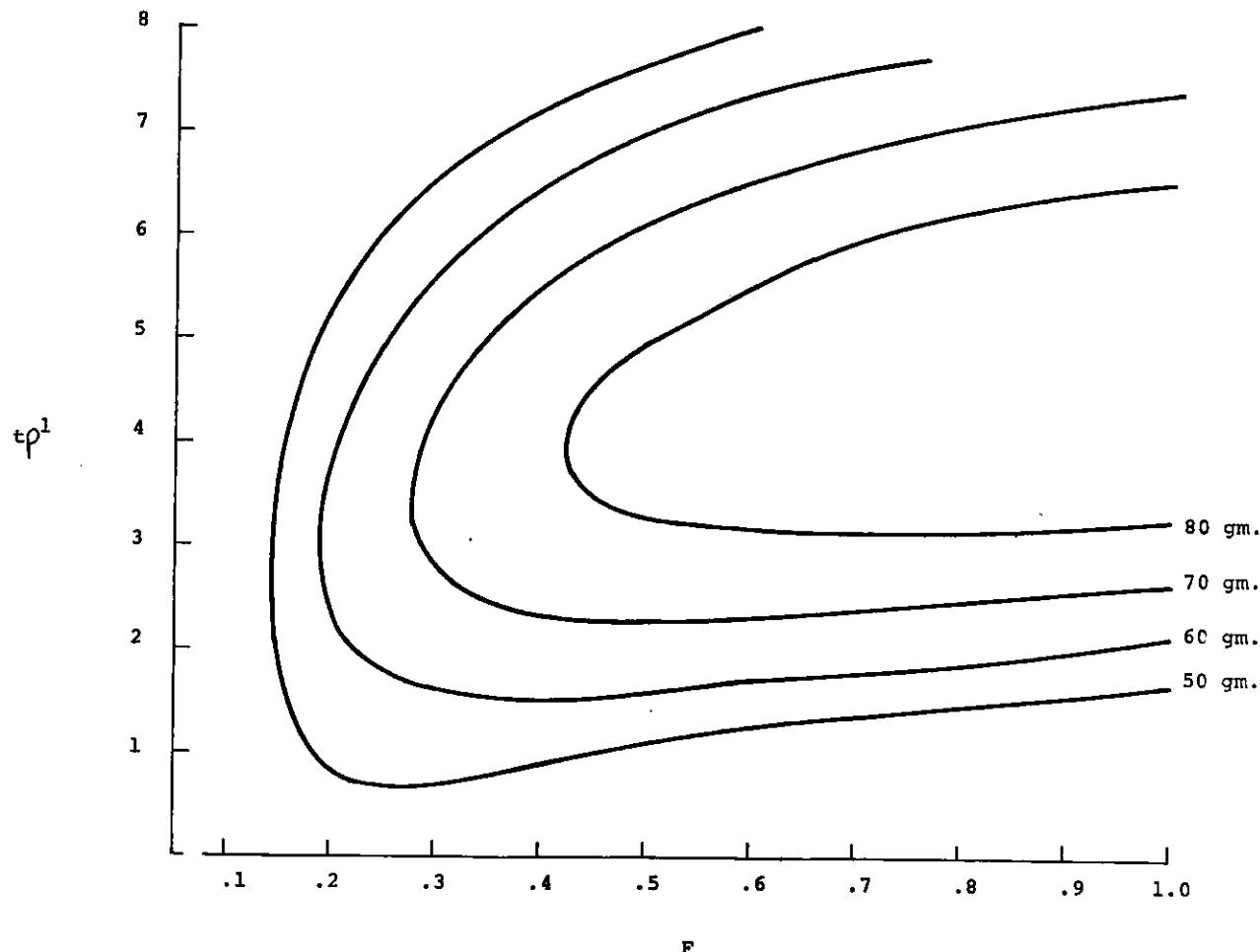


Fig. 1. Yield isopleth diagram for S.W. Nova Scotia herring
(assuming $M = 0.20$)

Fig 2. Relationship between stock size and catch per unit effort
in the Nova Scotia Purse Seine fishery

