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PROGNOSES OF YIELD AND ABUNDANCE OF SOUTHEAST
NEWFOUNDLAND HERRING FOR 1979

by

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INTRODUCTION

Herring fisheries in southeastern Newfoundland (St. Mary's, Placentia and Fortune Bays) have traditionally yielded a major proportion of the total herring landings in the Newfoundland area. During the period 1945 - 50 for example landings averaged 30,000 m tons equivalent to total landings of all herring fisheries in the Newfoundland area in recent years. During the 1950's and early 1960's landings remained at a very low level (< 3000 m tons) but increased during the late 1960's with the advent of purse seining and (more recently) ring-netting. Landings peaked at 21,000 m tons in 1968 but declined to less than 3900 m tons in 1977 due mainly to poor recruitment. Quotas were introduced in 1973 and these have prevented what would otherwise have been a much more precipitous decline in stock abundance than has been observed.

Tagging studies (Moores and Winters 1977) have shown that a portion of St. Mary's Bay herring over-winter in Placentia Bay and as such these areas have been treated as a unit stock for management purposes.

A. St. Mary's - Placentia Bay Catch Composition in 1978

Landings increased slightly to 3400 m tons in 1978 (Table 1), a shortfall of 600 tons in relation to the 1978 TAC (4000 m tons). The shortfall was mainly attributed to lack of effort by the ring-net fleet operating in Placentia Bay during the winter fishery (100 m ton allocation). The relative catch composition both with regard to gear type (mobile gear versus inshore gears) and area caught (St. Mary's Bay versus Placentia Bay) was very similar to that observed during the 1977 fishery.

Age composition data (Fig.1) of commercial catches in 1978 continued to reflect the predominance of younger fish in Placentia Bay whereas older fish (10+) comprised 80% of the catches in St. Mary's Bay, traditionally a mature (spawning) fish operation. The 1974 yearclass accounted for nearly 45% of the landings in Placentia Bay but only 7% in St. Mary's Bay where the 1968 yearclass continued to predominate. These age composition data suggest a very weak 1975

yearclass and a 1976 yearclass which is certainly not large.

Assessment Parameters

The previous assessment of this stock (Moore and Winters 1977) provided three estimates of fishing mortality in 1977 ranging from 0.15 to 0.18. Recognizing the tenuous nature of the effort data for this stock, a conservative value of $F_T = 0.20$ was selected as the input level in 1977 assessment. Effort data are not available for 1978 (only one comparable vessel participated) and trial runs of cohort analyses beginning in 1978 suggest that the estimates of $F = 0.20$ for 1977 remain essentially unchanged. Thus a value of $F_T = 0.24$ was selected as the input value in 1978 commensurate with a value of $F = 0.20$ in 1977.

Partial recruitment rates are those estimated by Moore and Winters (1977). Table 2 presents a comparison of predicted catch-at-age relative to that observed for the 1978 fishery. Accepting the estimate of $F_T = 0.24$ implies that the strength of the 1974 yearclass (and hence the 1977 partial recruitment rates) as estimated by Moore and Winters (1977) from cohort analyses to be reasonably accurate and that the oldest age-groups were somewhat underestimated.

Results of Assessment

Cohort analyses (Table 3 and Fig. 2) indicate a continued decline in abundance of this stock from a peak of 75000 m tons (2+) in 1972 to 18000 m tons in 1978. Fishing mortalities have been moderately low ($.09 \leq F \leq .25$) implying poor recruitment as the main reason for stock alteration. The most recent yearclass of any significance (1974) is less than one-eighth the strength of the last large yearclass (1968) and initial estimates of the 1975 and 1976 yearclasses are not encouraging. Furthermore the percentage of fall-spawners has increased from less than 7% in 1976 to 9% in 1977 and to 14% in 1978 mainly due to young fish (4 ringer). It is possible that the low temperatures experienced during the period 1974-77 (Station 27 surface temperatures) may have sufficiently delayed the seasonal period of first maturation such that a portion of the 1974 yearclass spawned as (fall - summer) spawners rather than spring-spawners.

A catch projection of $F_{0.1} = 0.30$ (Moores and Winters 1977) is shown in Table 4. Using the ratio of total catch to catch of spring-spawners for 1978 (1.12) suggests a level of removals of 3800 m tons. Inshore catches during the last two years have fluctuated around 800 m tons implying a residual optimal yield for the regulated fleet of 3000 m tons.

B. Fortune Bay

Catch composition in 1978

Landings from this stock increased from less than 600 tons in 1977 to 950m tons in 1978 (Table 5) mainly due to bar seine catches.

Age-composition data (Fig. 1) indicate a continued high predominance of the 1974 yearclass which accounted for nearly 65% of the removals in 1978. Juvenile fish (age groups 2 - 3) did not contribute significantly to catches in 1978, suggesting that these yearclasses (1975-76) are not of substantial strength.

Assessment Parameters

Effort data, measured as purse-seiner operating days, have not been available for this fishery since 1973, mainly due to the lack of purse-seine effort in Fortune Bay in recent years. The previous assessment of this stock (Winters and Moores 1977) utilized $F_T = 0.10$ in 1977 as the input value of F giving the best correlation between fishing effort and F for the period 1967-73. Five runs of cohort analyses beginning in 1978 indicate that the estimate of $F = 0.10$ for 1977 remains essentially unchanged. Thus a value of $F_T = 0.15$ was selected as the input value in 1978 commensurate with a value of $F = 0.10$ in 1977.

Table 2 presents a comparison of predicted catch-at-age relative to that observed for the 1978 fishery. Accepting the estimate of $F_T = 0.15$ for 1978 implies that the strength of the 1974 yearclass (and hence the partial recruitment rate in 1977) as estimated by Winters and Moores (1977) is reasonably accurate.

Results of Assessment

Cohort analyses (Table 6) and Fig. 2 indicate a decline in abundance from 44,000 m tons in 1970 (2+) to slightly over 6000 m tons in 1975, increasing to 8100 m tons by 1978. Fishing mortalities have been very low since 1974 enabling the stock to stabilize its abundance.

The 1974 yearclass has been the strongest to appear in this stock since the large 1968 yearclass. However, its strength is less than one-quarter that of the 1968 and most recent yearclass (1975-76) do not appear to be strong.

A catch projection at $F_{0.1} = 0.30$ (Winters and Moores 1977) is shown in Table 7. The predicted optimal yield for 1979 is 1800 m tons. Inshore catches from this stock have averaged less than 100 m tons, suggesting a residual yield of 1700 m tons for the regulated fleet.

ACKNOWLEDGEMENTS

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REFERENCES

- Moores, J.A. and G.H. Winters. 1977. Production and yield of the Placentia-St. Mary's herring stock. CAFSAC Res. Doc. 77/30, 16 p.
- Winters, G.H. and J.A. Moores. 1977. Analysis of stock size and yield of Fortune Bay herring. CAFSAC Res. Doc. 77/29, 14 p.

Table 1

- 5 -

Herring landings by gear, St. Mary's - Placentia Bay 1977-78

YEAR	AREA	Catch (m tons) by Gear				TRAP	TOTAL
		P. SEINE	RING NET	BAR SEINE	GILLNET		
1977	St. Mary's	-	1131	221	531	29	1912
	Placentia	739	523	14	78	-	1354
TOTAL		739	1654	235	609	29	3266
1978	St. Mary's	-	1523	66	459	3	2051
	Placentia	557	547	27	195	31	1357
TOTAL		557	2070	93	654	34	3408

Jan. - June only

Table 2

Observed age-specific catches in 1978 in relation to those predicted for equivalent catches from population numbers at age (Winters and Moores 1977, Moores and Winters 1977)

AGE	St. Mary's - Placentia		Fortune Bay	
	PREDICTED	OBSERVED	PREDICTED	OBSERVED
2	1210	75	30	-
3	80	175	425	60
4	2500	2000	2685	2425
5	275	120	32	60
6	560	505	320	280
7	60	50	165	10
8	35	75	25	120
9	740	240	50	30
10	2760	3280	190	405
11	1700	2080	240	255

F₅₊

.23

.24

.15

.15

TABLE 3

PLACENTIA - ST. MARY'S

ESTIMATED POPULATIONS										
AGE	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978
2	19736.	266750.	17219.	3279.	2611.	14565.	1957.	33823.	3657.	3674.
3	128904.	16158.	217935.	14097.	2677.	2068.	11014.	1534.	27377.	2966.
4	14664.	104932.	13127.	177923.	11421.	1893.	1433.	6983.	962.	21179.
5	11389.	12117.	81736.	10638.	127100.	9281.	1334.	744.	4281.	659.
6	14746.	9274.	9865.	64881.	7815.	91898.	7072.	955.	442.	2838.
7	3298.	11696.	7520.	8000.	48698.	3053.	62340.	4327.	571.	278.
8	2996.	2636.	8967.	6119.	5876.	33455.	1869.	38370.	2810.	422.
9	9502.	2402.	2096.	7109.	4614.	3513.	22165.	1396.	26757.	1355.
10	5334.	7685.	1699.	1704.	5296.	3610.	2736.	15051.	978.	18418.
11	3235.	4034.	6246.	1534.	1316.	4123.	2744.	1917.	10604.	675.
12	29.	2317.	3257.	5083.	1187.	1026.	3137.	1922.	1349.	7296.
13	23.	23.	1851.	2637.	4060.	927.	781.	2200.	1351.	927.
14	18.	18.	18.	1487.	2060.	3258.	710.	549.	1550.	927.
15	13.	13.	13.	13.	1121.	1622.	2593.	504.	388.	1066.
16	10.	10.	10.	10.	10.	857.	1256.	2009.	360.	268.
17	7.	7.	7.	7.	7.	7.	633.	917.	1567.	252.
18	5.	5.	5.	5.	5.	5.	5.	412.	675.	1221.
TOTAL POPULATION										
	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978
WT	39753.6	59257.1	72100.9	75109.8	58172.2	45897.3	33255.8	25622.8	22001.5	17889.1
NO	214168.	446076.	371770.	304527.	225874.	175162.	123780.	113615.	85679.	64423.
POPULATION AT AGE 5 TO 18										
	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978
WT	14572.8	14940.6	33044.9	30832.8	54893.0	44189.4	31031.4	21571.5	17161.0	12202.2
NO	50604.	52236.	123490.	109228.	209166.	156636.	109376.	71274.	53683.	36603.
WEIGHTED F										
AGE 5 TO 18	0.032	0.024	0.025	0.086	0.150	0.171	0.239	0.167	0.201	

STOCK PROJECTION AREA GER SPRING SPANERS '000

St. Mary's
Placehia

Table 4-

NATURAL MORTALITY# 0.2000		YEAR 1978		NATURAL MORTALITY# 0.2000		YEAR 1979	
AGE	POP. NO. %X10-3<	CATCH NO. %X10-3<	FISHING MORT.	MEAN WT. KG.	POP. WT. %METRIC TONS<	CATCH WT. %METRIC TONS<	RESIDUAL POP. NOS.
TOTAL	64425.	9548.		18856.5	3085.1	44124.1	
2	3674.	79.	0.025	293.9	6.3	2933.7	
3	2966.	187.	0.073	459.7	29.0	2257.4	
4	2179.	2175.	0.121	5083.0	522.0	15363.7	
5	659.	128.	0.241	194.4	37.8	424.0	
6	2838.	551.	0.240	894.0	173.5	1827.8	
7	278.	54.	0.241	90.3	17.5	178.9	
8	422.	82.	0.241	139.3	27.1	271.5	
9	1355.	263.	0.240	453.9	88.1	872.7	
10	18410.	3576.	0.240	6446.3	1251.5	11861.9	
11	675.	131.	0.240	256.5	49.8	434.7	
12	7298.	1417.	0.241	273.2	538.5	4695.5	
13	928.	180.	0.240	352.6	68.4	597.7	
14	928.	180.	0.240	352.6	68.4	597.7	
15	1066.	207.	0.241	405.1	78.7	685.9	
16	268.	52.	0.240	101.8	19.8	172.6	
17	252.	49.	0.241	95.8	18.6	162.1	
18	1221.	237.	0.240	464.0	90.1	786.4	

NATURAL MORTALITY# 0.2000		YEAR 1979		NATURAL MORTALITY# 0.2000		YEAR 1979	
AGE	POP. NO. %X10-3<	CATCH NO. %X10-3<	FISHING MORT.	MEAN WT. KG.	POP. WT. %METRIC TONS<	CATCH WT. %METRIC TONS<	RESIDUAL POP. NOS.
TOTAL	57703.	1546.	0.030	4616.2	123.7	45847.1	
2	2934.	229.	0.090	454.7	35.5	2195.2	
3	2257.	286.	0.150	541.8	68.6	1590.8	
4	15354.	3627.	0.300	4532.3	1070.0	9318.6	
5	424.	100.	0.300	133.6	31.5	257.2	
6	1828.	432.	0.300	594.0	140.2	1108.5	
7	179.	42.	0.300	59.0	13.9	108.5	
8	272.	64.	0.300	91.0	21.5	164.7	
9	873.	206.	0.300	305.4	72.1	529.3	
10	11862.	2800.	0.300	4507.5	1064.1	7194.5	
11	435.	103.	0.300	165.2	39.0	263.7	
12	4695.	1109.	0.300	1784.3	421.2	2848.0	
13	598.	141.	0.300	227.1	53.6	362.5	
14	598.	141.	0.300	227.1	53.6	362.5	
15	686.	162.	0.300	250.6	61.5	416.0	
16	173.	41.	0.300	65.6	15.5	104.7	
18	949.	224.	0.300	360.4	85.1	575.3	

3370.8 (X1.12) 73246.9

18925.9

11253.

101827.

TOTAL

Table 5

Herring landings by gear, Fortune Bay 1977-78

YEAR	Catch (m tons) by gear			TOTAL
	P. SEINE	BAR SEINE	GILLNET	
1977	188	363	26	577
1978	104	808	33	945

Jan. - June only

TABLE 6. FORTUNE BAY

	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978
2	29550.	157577.	2331.	7609.	6316.	6915.	884.	38186.	1149.	0.
3	106230.	23727.	90663.	1751.	4840.	3162.	5310.	722.	31190.	915.
4	3820.	76130.	12190.	52428.	1198.	3126.	1383.	4095.	578.	23624.
5	1531.	3051.	52890.	4268.	24850.	921.	2068.	606.	3065.	450.
6	58738.	1084.	2419.	21263.	833.	15214.	644.	1592.	290.	2212.
7	1008.	36293.	716.	886.	7513.	271.	8318.	449.	1187.	87.
8	1135.	655.	23098.	406.	402.	4568.	116.	5462.	357.	948.
9	2362.	693.	318.	10419.	233.	259.	2728.	81.	4167.	253.
10	3062.	1310.	553.	137.	3643.	145.	204.	2105.	33.	3240.
11	1452.	756.	860.	315.	80.	2269.	101.	147.	1554.	24.
12	961.	389.	492.	468.	185.	52.	1590.	75.	108.	1146.
13	60.	250.	261.	261.	259.	121.	38.	1157.	54.	79.
14	358.	26.	166.	148.	139.	160.	89.	28.	856.	40.
15	19.	109.	20.	92.	87.	82.	114.	67.	22.	632.
16	14.	14.	75.	14.	53.	57.	56.	84.	52.	16.
17	11.	11.	11.	46.	11.	33.	42.	41.	63.	40.
18	8.	8.	8.	8.	32.	8.	24.	32.	32.	47.

TOTAL POPULATION

	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978
VT	37828.4	43809.6	37554.1	23049.1	11736.1	8825.7	6186.5	7590.9	8324.7	8098.3
NO	216318.	302084.	187072.	100518.	50674.	37365.	23709.	54927.	44755.	33751.

POPULATION AT AGE 5 TO 18

	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978
	20313.2	13822.1	22366.2	11474.6	10379.2	7261.2	5107.0	3974.7	3821.1	3105.6
	70718.	44650.	81887.	38731.	38319.	24161.	16132.	11924.	11838.	9213.

	0.331	0.232	0.665	0.856	0.300	0.341	0.154	0.107	0.101
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STOCK PROJECTION AREA I SS 1000

TABLE 7

Fortuna Bay

NATURAL MORTALITY# 0.2000		YEAR 1978		NATURAL MORTALITY# 0.2000		YEAR 1979	
AGE	POP. NO. %X10-3<	CATCH NO. %X10-3<	FISHING MORT.	MEAN WT. KG.	POP. WT. %METRIC TONS<	CATCH WT. %METRIC TONS<	RESIDUAL POP. NOS.
TOTAL	40388.	3653.			8740.9	920.2 (x103)	29765.7
2	6636.	1.	0.001	0.070	464.5	0.1	5427.7
3	915.	60.	0.076	0.160	146.4	9.5	694.3
4	23624.	2426.	0.120	0.210	4961.0	509.5	17154.6
5	450.	57.	0.151	0.255	114.7	14.5	316.8
6	2212.	280.	0.151	0.300	663.6	84.0	1557.2
7	87.	11.	0.150	0.320	27.8	3.5	61.3
8	948.	120.	0.151	0.335	317.6	40.2	667.4
9	253.	32.	0.150	0.355	89.8	11.4	178.3
10	3240.	410.	0.150	0.360	1166.4	147.6	2283.2
11	24.	3.	0.149	0.390	9.4	1.2	16.9
12	1146.	145.	0.150	0.390	446.9	56.5	807.6
13	79.	10.	0.151	0.390	30.8	3.9	55.6
14	40.	5.	0.149	0.390	15.6	1.9	28.2
15	632.	80.	0.151	0.390	246.5	31.2	444.9
16	16.	2.	0.149	0.390	6.2	0.8	11.3
17	40.	5.	0.149	0.390	15.6	1.9	28.2
18	45.	6.	0.155	0.390	17.9	2.3	32.3

NATURAL MORTALITY# 0.2000		YEAR 1979		NATURAL MORTALITY# 0.2000		YEAR 1978	
AGE	POP. NO. %X10-3<	CATCH NO. %X10-3<	FISHING MORT.	MEAN WT. KG.	POP. WT. %METRIC TONS<	CATCH WT. %METRIC TONS<	RESIDUAL POP. NOS.
TOTAL	30643.	6579.			7811.2	1750.9 (x1.03)	19172.6
2	877.	58.	0.075	0.070	61.4	4.0	666.3
3	5428.	813.	0.180	0.160	868.4	130.0	3711.8
4	694.	127.	0.225	0.210	145.8	26.7	453.9
5	17155.	4050.	0.300	0.255	4374.4	1032.7	10404.8
6	317.	75.	0.300	0.300	95.0	22.4	192.1
7	1557.	368.	0.300	0.320	498.3	117.5	944.5
8	61.	14.	0.300	0.335	20.5	4.8	37.2
9	667.	158.	0.300	0.355	236.9	55.9	404.8
10	178.	42.	0.300	0.360	64.2	15.2	108.1
11	2283.	539.	0.300	0.390	890.4	210.2	1384.8
12	17.	4.	0.300	0.390	6.6	1.6	10.3
13	808.	191.	0.300	0.390	315.0	74.4	489.8
14	56.	13.	0.300	0.390	21.7	5.1	33.7
15	28.	7.	0.300	0.390	11.0	2.6	17.1
16	445.	105.	0.300	0.390	173.5	41.0	269.9
17	11.	3.	0.300	0.390	4.4	1.0	6.8
18	60.	14.	0.300	0.390	23.6	5.6	36.7

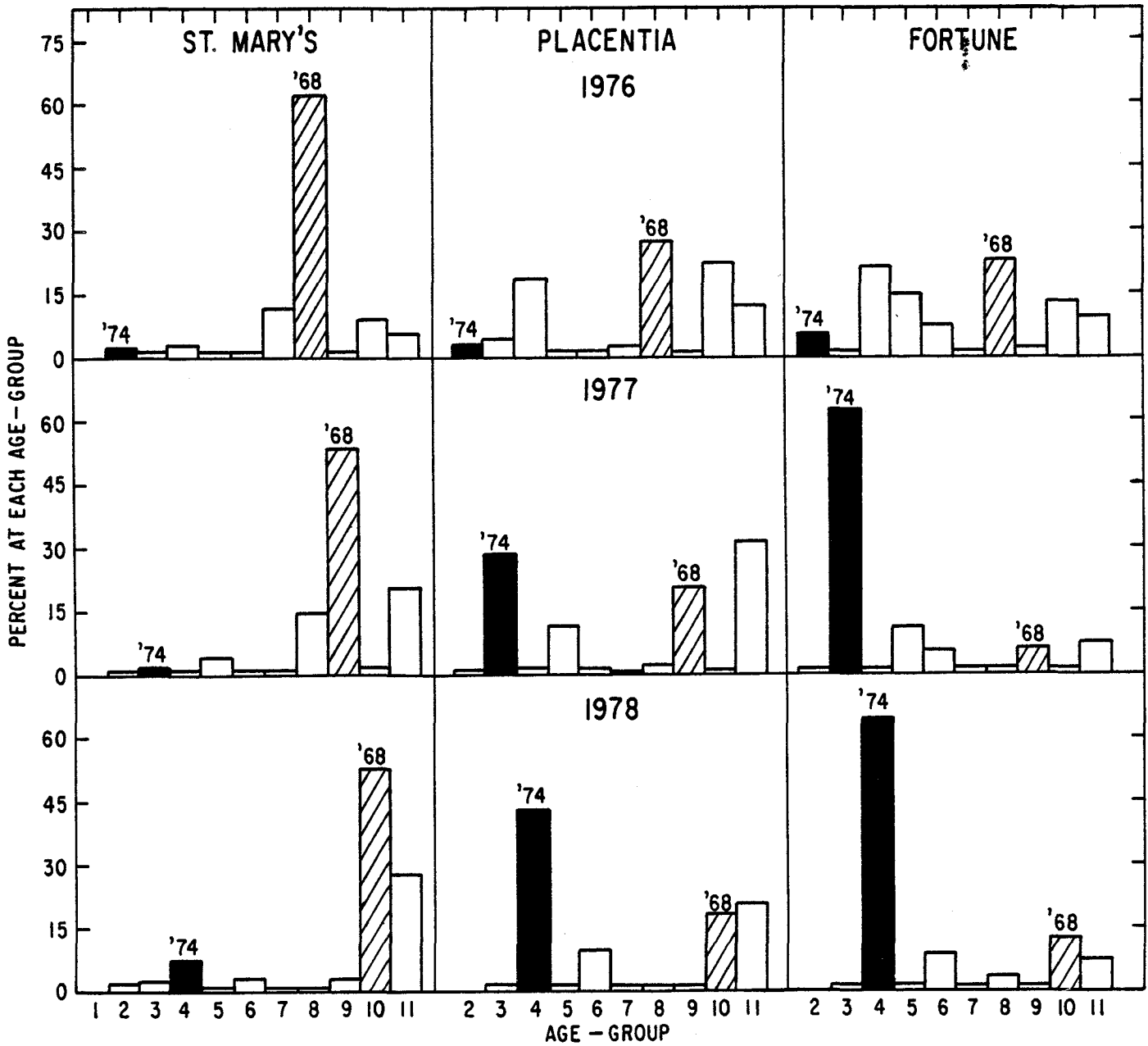


Fig. 1. Age composition data, St. Mary's, Placentia and Fortune bays for the period 1976-78.

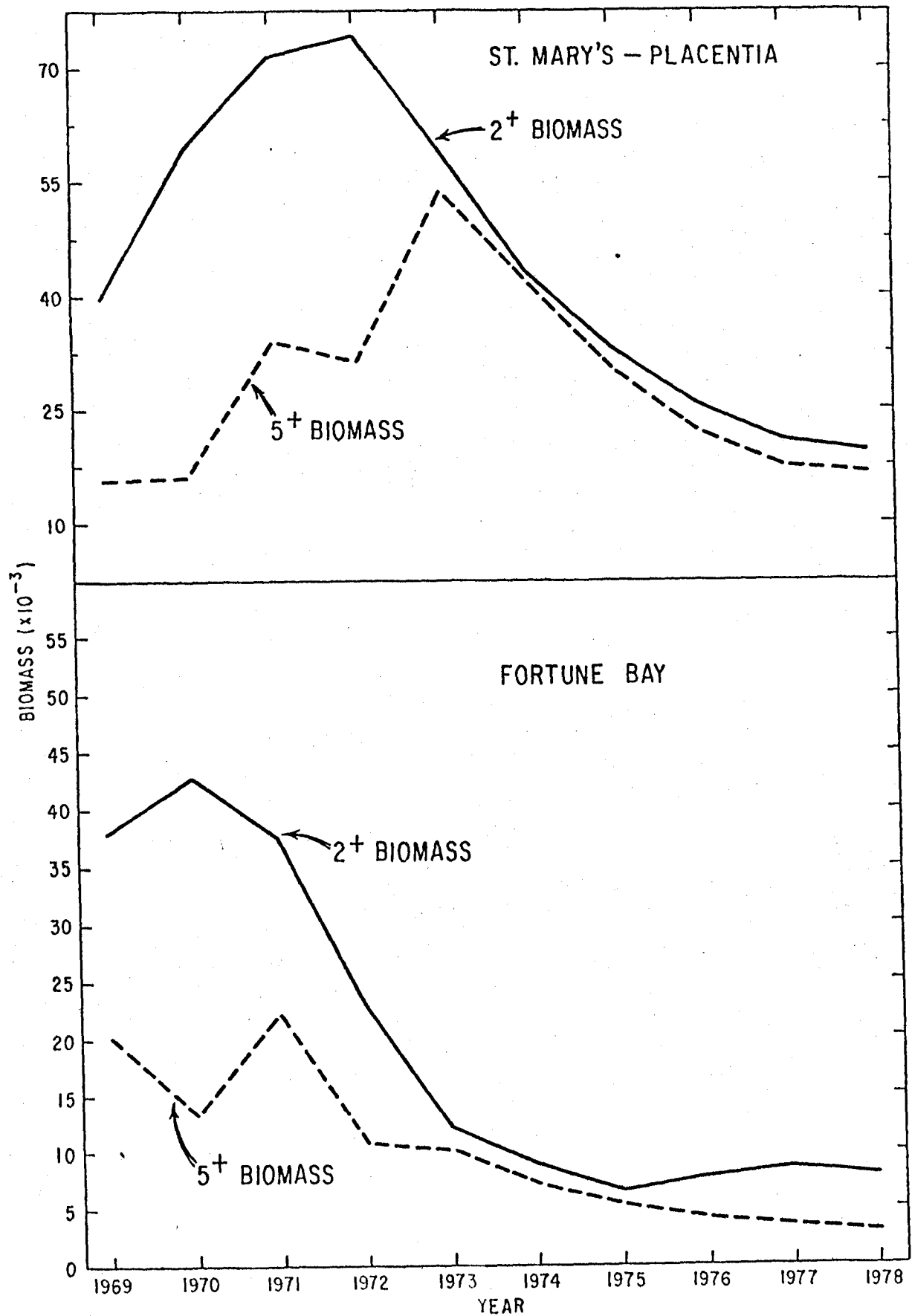


Fig. 2. Trends in biomass levels of the St. Mary's-Placentia and Fortune bays herring stocks