

The Newfoundland west coast herring stocksNOT TO BE CITED WITHOUT
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by

J.A. Moores and G.H. Winters

Introduction

In 1977 a new herring management area was defined for coast of Newfoundland, encompassing the area from Cape Anguille to Cape Norman. A TAC of 12,000 mt was recommended by the Atlantic Herring Management Committee of which 10,000 mt were allocated to the mobile fleet. To spread the effort over the entire area and prevent possible overexploitation of local stocks, the quota area was broken down into three subareas: (a) St. George's Bay (4000 mt), (b) Cape St. George to Cape Gregory (2400 mt), and (c) Cape Gregory to Cape Norman (3600 mt).

The 1977 Fishery

The 1977 catch was 12,300 mt which was an increase of 20% over the 1976 landings (Table 1). This increase was observed for both the mobile and inshore components of the fishery with the inshore catch increasing by 40% (2818 mt) and the purse seine catch increasing by 15% (9454 mt).

The increased inshore catch was due mainly to a doubling of the gillnet catch in St. John Bay from 1009 mt in 1976 to 2025 mt in 1977.

The purse seine fleet took 95% of its total allocation. The quota for St. George's Bay was exceeded by 30%, but this was offset by a shortfall of 1500 mt in the quota for Cape Gregory to Cape Norman area. The failure of the fleet to take the full quota in the Cape Gregory to Cape Norman area does not appear to be a function of availability, but rather due to the poor weather conditions which occur in the area at the time of the fishery.

Tagging Data

During 1977 two tagging experiments were conducted along the west coast of Newfoundland. In April, 7500 tags were applied in St. George's Bay and, in May, 2000 tags were applied off the Port-au-Port peninsula. The tag returns from these and previous experiments (Table 3) indicate that the designation of the west coast Newfoundland management unit is reasonable.

All of the returns from taggings conducted in the stock area have been reported from within the area with the exception of 1 tag which was recovered in southern Labrador. The returns also indicate that the stock is highly migratory and is exploited at different times of the year throughout the unit area.

Tagging studies conducted in the southern Gulf of St. Lawrence and the west coast of Newfoundland indicate that these two stocks are distinct. Of 827 returns received from these areas from 1976 and 1977, only one case of cross-over was reported with a fish tagged on the 'edge' being recaptured off the Port-au-Port peninsula.

Of interest, however, is the recapture in the St. George's Bay-Port-au-Port area of 17 herring, tagged along the east coast of Newfoundland. Although these returns occurred in the spring of 1977 and came from plants which had processed herring caught along the east coast of Newfoundland during the fall of 1976, it is not possible to attribute them to late east coast returns. Both these stocks show northward feeding migration during the summer and, if they should mix in the northern Gulf or off Southern Labrador, interchange could easily occur. If this were the case, it would be expected that herring tagged on the west coast would be recaptured along the east coast of Newfoundland, however, to date no such reports have been received.

Compilation of Assessment Data

Age data and No's-at-age

Samples were collected from the commercial fisheries in each of the three quota areas. Numbers-at-age in the catch were generated separately for each area then combined for a unit assessment.

The age composition of the catch was similar to that observed in 1976 (Fig. 1). The 1968 year-class remained dominant among spring spawners, representing 55% of the catch of spring spawners. The majority of the catch of fall spawners continued to be old fish with 77% being in the 10+ age group.

There was some variability in the age composition between areas, particularly the Cape St. George-Cape Gregory area where the dominant age group in the catch of both spring and fall spawners was 10+ at 37% and 92%, respectively (Fig. 2).

Partial recruitment rates

The partial recruitment rates used were the same as those calculated in 1976 (Table 4). These values were estimated from an examination of the partial F values generated from cohort analysis.

Catch per unit effort and fishing effort

Log records from the purse seine fleet were available from 1966-73 and 1976 for the Cape Gregory-Cape Norman area and for St. George's Bay from 1975-77. A comparison of catch/operating day between Cape Gregory-Cape Norman (from logs in 1976 and landing data, 1977) and St. George's Bay was used to factor (2.4X St. George's Bay) to adjust St. George's

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Bay effort to the time series available for Cape Gregory-Cape Norman (Table 5).

The catch per operating day has shown a steady decline in St. George's Bay since 1975, which corresponds to the passage of the 1968 year-class of spring spawners through the fishery.

Calculation of terminal F

Cohort analysis was performed individually for both spring and autumn spawners at a range of F values from 0.15 to 0.40 with an $M = 0.20$. An F_{5+} for the total population was calculated by proportioning the F_{5+} for spring and fall spawners on the basis of the number of individuals aged 5+ of each in the total population. The F_{5+} values were plotted against effort (Fig. 3) and regression analysis gave a value of $F_T = 0.19$ for 1977. Palohemo Z values were also calculated and indicated that F values for the population were low (Table 6). Therefore, a terminal F value of 0.20 was selected.

Results of Assessment

Trends in biomass and F

The biomass of both the spring and autumn spawning components of this stock declined from 1976. The 5+ biomass of the population in 1977 was 75,000 mt of which 56,700 mt were spring spawners (Table 6).

The trend of the population to move toward spring spawners, as observed in both the northern and southern gulf (Moore & Winters 1977), continued in 1977. The fall spawning component of the population declined from 21% in 1976 to 19% in 1977.

The fishing mortality ratio of both components has been low, particularly in the earlier years and fluctuations in biomass have been little affected by fishery removals except since 1973, when moderately high fishing mortalities have been observed.

Trends in recruitment

There does not appear to be any substantial recruitment among either the spring or autumn spawners. The 1974 year-class of spring spawners has shown up relatively strongly around the coast of Newfoundland, but preliminary analysis indicates that for the west coast, stock is only 1/10 as large as the 1968 year-class.

Estimation of F opt

The yield per recruit curve remained unchanged from 1977 and yielded an optimum fishing mortality rate (F_{opt}) of 0.45.

Catch projection

Catch projections were performed for the west coast herring stock using two options of F. Adult biomass at the start of 1978 was calculated to be 54,000 mt. At F_{opt} ($F = 0.45$) the biomass decline to 34,500 mt and yielded a catch of 17,700 mt. The value of F_{opt} for this stock is high in comparison to F_{opt} values calculated for herring stocks in the Southern Gulf and Nova Scotia which range between .30 and .35. A second projection was performed at $F = 0.35$. Under this option, the 1978 biomass declined to 37,700 mt and produced a catch of 14,500 mt.

The inshore catch has been increasing over the past three years and at 1977 took 2800 mt. Although the inshore catch has been variable, it is expected that the inshore catch in 1978 will be around the 1977 level (2500-3000 mt). Allowing 3000 mt for inshore catch and considering the two options of F, the portion of the TAC available to the regulated portion of the fleet would be between 11,500 mt and 14,700 mt.

The catch in 1978 and the biomass in 1979 were calculated for several levels of fishing mortality (Fig. 4). The results indicate that for the assumptions made in the cohort analysis, even with no fishing in 1978, the 1978 biomass will decline.

Discussion and Conclusions

The results of tagging studies conducted in 1976 and 1977 strengthens the arguments for treating the herring stocks from Cape Anguille to Cape Norman as a unit stock for management purposes. Although, treated as a unit it may better be regarded as a stock complex and care must be taken to prevent overexploitation of any one stock. This is particularly true in the case of St. George's Bay where the fishery is exerted primarily on pre-spawning concentrations of spring spawners. Therefore, it is advisable to partition the quota in some manner so as to spread the fishery effort over the seasons and areas where the stock is available for exploitation.

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Table 1. Newfoundland west coast landings 1966-77.

Herring Landings 1966-77 (mt)

Year	Area				Total	Inshore Catch
	K	L	M	N		
1966		103	5529	18	5650	373
1967		66	5540	13	5619	370
1968		59	3978	11	4048	291
1969		46	2549	40	2635	328
1970		27	3473	301	3801	897
1971		2424	1076	1963	5463	2684
1972		862	1544	3628	6034	4154
1973		2862	2067	9222	14,151	6570
1974		856	942	2842	4640	2536
1975	3613	113	242	1027	4995	1500
1976	6565	2067	226	1251	10,109	1904
1977	(5569)	(2204)	(156)	(4343)	(12,272)	(2818)

() Provisional catch figures for 1977.

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Table 2. Herring catches (mt) by area and gear for 1976 and 1977.

Area	Gear							
	Purse Seine		Gillnet		Other		Total	
	1976	1977	1976	1977	1976	1977	1976	1977
K	6067	5289	496	273	2	7	6565	5569
L	1955	2010	111	192	1	2	2067	2204
M	-	-	226	156	-	-	226	156
N	184	2155	1009	2025	58	163	1251	4343
Total	8206	9454	1842	2646	61	172	10109	12272

Table 3. Results of tagging studies related to the west coast of Newfoundland and herring stocks.

Area tagged	Date tagged	No tagged	Area recaptured	Year		Total
				1976	1977	
1. St. George's Bay	April/76	6400	St. George's Bay Port-au-Port	93 1	46 1	139 2 } 141
2. the "Edge"	May/76	3800	the "Edge" E-y Chaleur Chedabucto Bay Port-au-Port	126 13 - -	24 - 1 1	150 13 1 1 } 165
3. St. John Bay	Dec./76	10,000	St. John Bay St. George's Bay Port-au-Port Hare Bay Labrador	9 - - -	2 109 13 2 1	11 109 13 2 1 } 136
4. St. George's Bay	April/77	7500	St. George's Bay Port-au-Port	366 11	366 11	366 11 } 377
5. Port-au-Port	May/77	2000	Port-au-Port St. John Bay	5 3	5 3	5 3 } 8
6. East coast taggings (Notre Dame to Hare Bay)	1976	15,150	St. George's Bay Port-au-Port	14 3	14 3	14 3 } 17

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Table 4. Partial recruitment rates for area K-N.

Age	2	3	4	5	6	7	8	9	10	10 ⁺
% recruited										
Spring spawners	5	15	25	50	75	90	100	100	100	100
Autumn spawners	5	15	40	65	90	100	100	100	100	100

Table 5. Catch, effort and F data for Newfoundland West Coast.

Year	Catch	Catch/op. day	Effort	Population F
1966	5649	63.3	89.2	.027
1967	5618	65.1	86.3	.028
1968	4046	63.0	64.2	.022
1969	2637	47.9	55.1	.013
1970	3798	38.9	97.6	.020
1971	5461	38.7	141.1	.040
1972	6033	31.7	190.3	.039
1973	14,103	53.1	265.6	.111
1974	4644	-	-	.038
1975	4995	92.62	129.53	.052
1976	10,109	90.92	269.63	.155
1977	12,272 ¹	84.52	348.63	

¹ Provisional

² St. George's Bay only

³ adjusted St. George's Bay (x 2.4)

Table 6. Biomass and F_{5+} values from cohort analysis $F_T = 0.20$.

	Year											
	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977
Biomass 5+ AS	165.1	142.2	132.7	121.2	108.9	91.3	72.6	58.3	41.6	34.8	27.4	18.3
(10^{-3} mt) SS	61.5	54.3	50.2	43.6	42.1	52.5	49.6	112.5	104.7	86.7	71.8	56.7
Total	226.6	196.5	182.9	164.8	151.0	143.8	122.2	170.8	146.3	121.5	99.2	75.0
F_{5+} AS	.014	.016	.015	.009	.012	.057	.047	.202	.056	.077	.224	
SS	.055	.054	.036	.024	.040	.016	.030	.077	.032	.044	.134	
Combined	.027	.028	.022	.013	.020	.040	.039	.111	.038	.052	.155	
Palohimo Z	0.11	0.10	0.56	0.36	-0.20	0.54	-0.43	-	-	0.06	0.08	

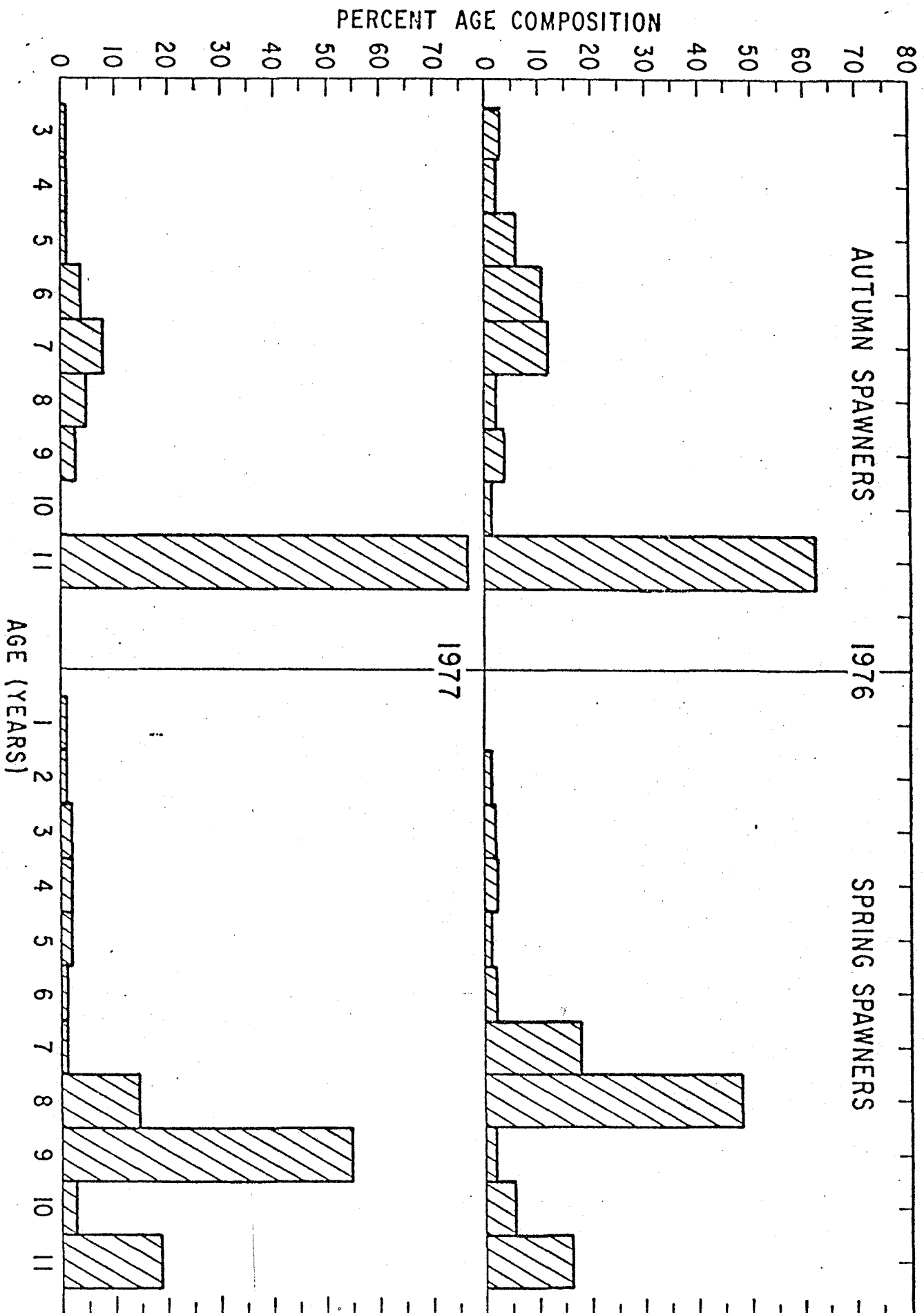


Fig. 1. Age frequencies adjusted to landings for west coast Newfoundland herring stock.

PERCENT AGE COMPOSITION

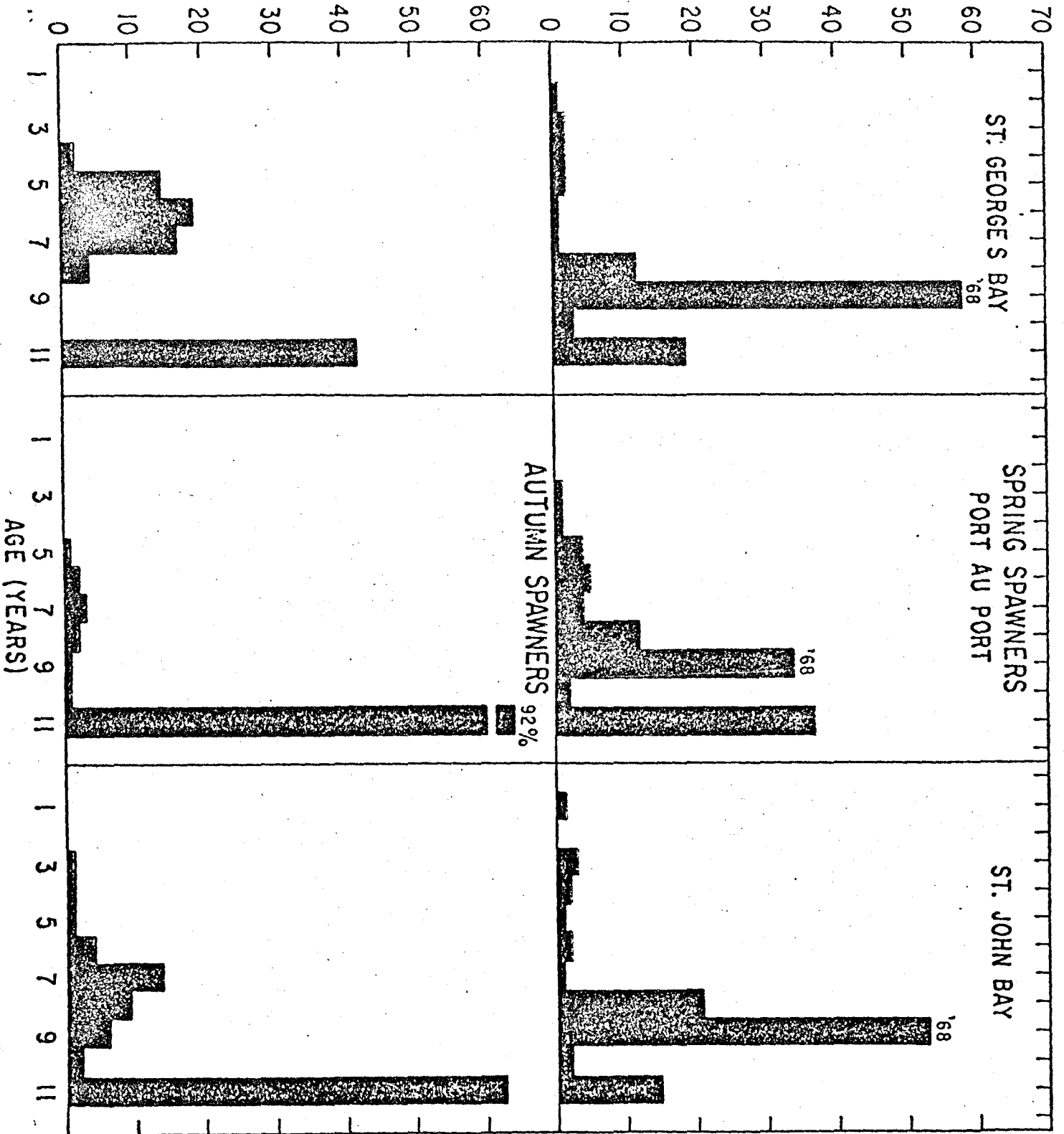


Fig. 2. Age frequencies adjusted to landings for sub-areas of west coast Newfoundland herring stock.

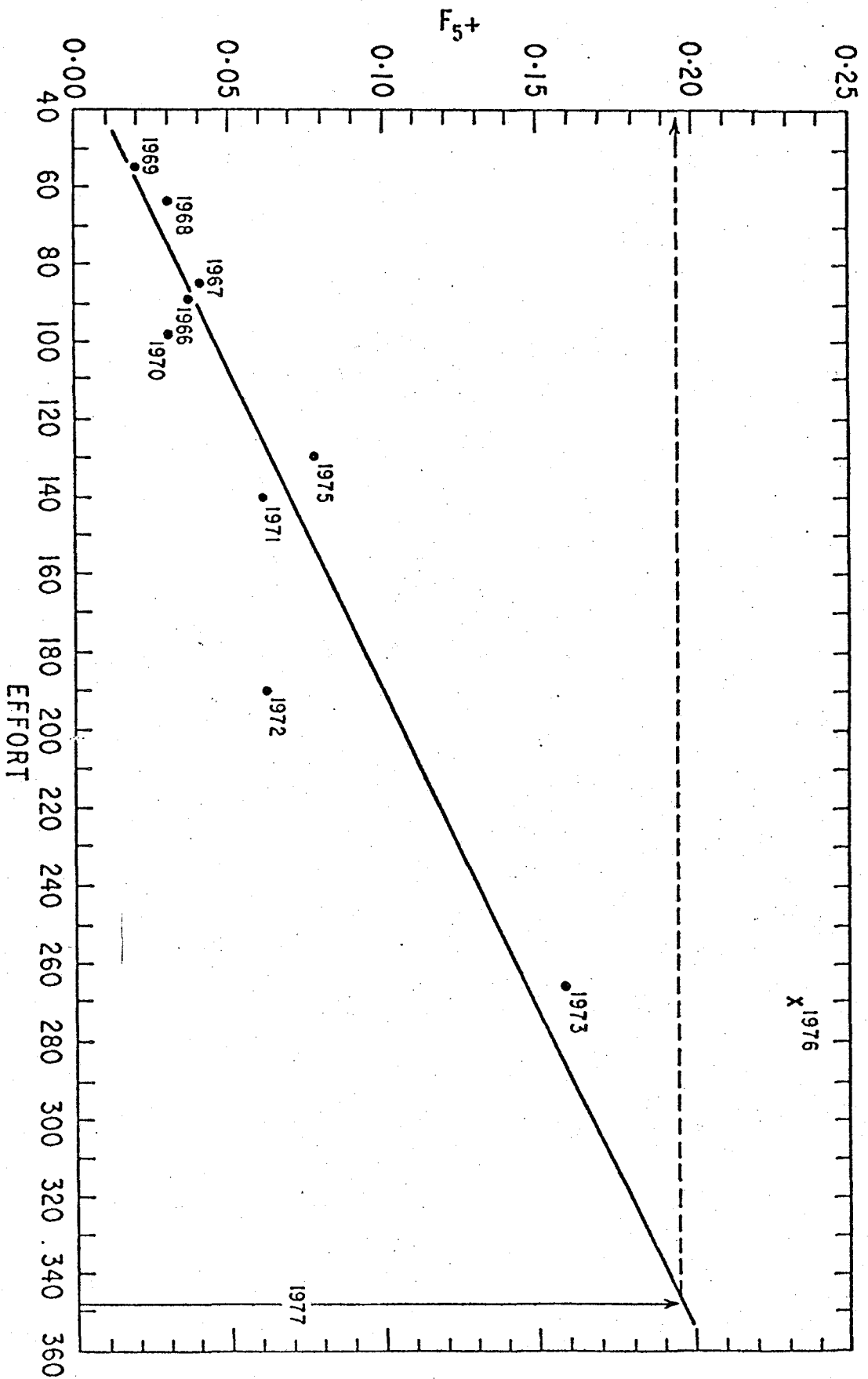


Fig. 3. Effort vs F_{5+} for west coast Newfoundland.

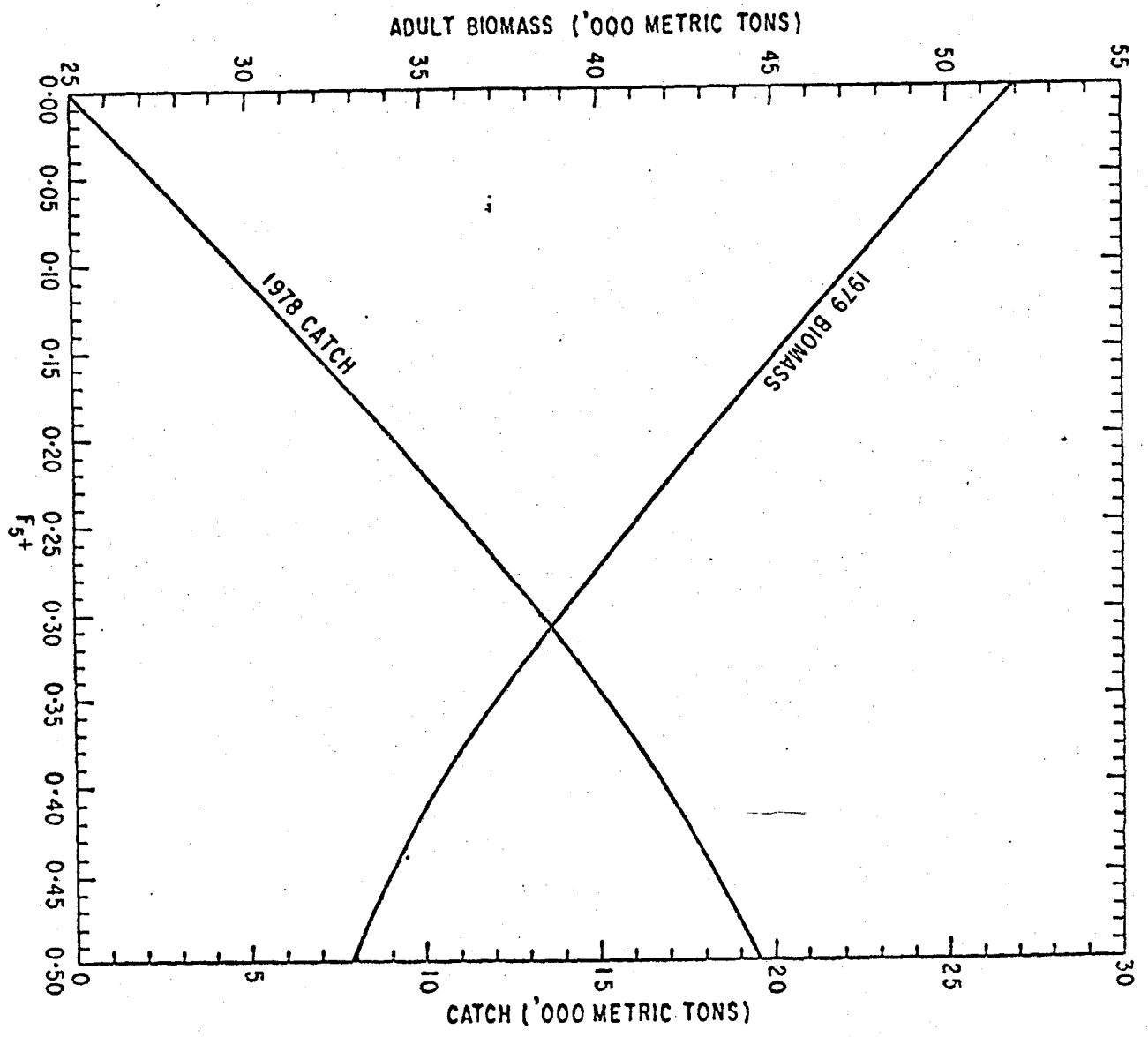


Fig. 4. Relationship between fishing mortality and catch in 1978 and the subsequent 1979 adult biomass level (spring- and fall-spawners combined).

HERRING AREA KLMN 1966-77 AGES 2-18 AS'000

NATURAL MORTALITY= 0.20

ASSUMED FISHING MORTALITY FOR LAST AGE = 0.20

ESTIMATED POPULATION FOR LAST YEAR
6. 6. 6. 6. 6. 6. 6. 13995. 3670. 3773. 11617. 21390.

PREDETERMINED FISHING MORTALITY USED FOR LAST YEAR

0.20000
0.20000
0.20000
0.20000
0.20000
0.20000
0.20000
0.20000
0.20000
0.20000
0.20000
0.20000
0.20000
0.18000
0.13000
0.08000
0.03000
0.01000

AGE	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977
2	57860.	17935.	8734.	7102.	7728.	11557.	15159.	5465.	2187.	1390.	229.	111.
3	85359.	47371.	14683.	7150.	5800.	6327.	9435.	12400.	4473.	1789.	1137.	187.
4	21677.	69885.	38780.	11021.	5583.	4052.	5179.	7652.	9888.	3652.	1380.	874.
5	32880.	17175.	57213.	31629.	9198.	4443.	3315.	4156.	5843.	7967.	2824.	1084.
6	35050.	26667.	13632.	46656.	25650.	7400.	3588.	2652.	2833.	4683.	5448.	2204.
7	207410.	28451.	21559.	10199.	37644.	20607.	5748.	2713.	1642.	2268.	3518.	4156.
8	118059.	169561.	23190.	17386.	7883.	30397.	16175.	4412.	1341.	1237.	1782.	2445.
9	39886.	95752.	138547.	18782.	14092.	6295.	23025.	12861.	2671.	1045.	912.	1347.
10	29670.	31652.	77531.	113164.	15270.	11421.	4165.	18043.	8520.	2011.	792.	595.
11	80955.	23442.	24855.	62357.	92500.	12285.	8705.	3179.	12948.	6740.	1593.	595.
12	32.	63720.	18441.	19773.	50673.	75506.	9364.	6639.	2284.	10243.	5339.	1195.
13	25.	25.	49906.	14688.	15993.	40919.	61093.	7141.	4764.	1808.	8114.	4004.
14	20.	20.	20.	39623.	11887.	12802.	31677.	49470.	5125.	3769.	1432.	6085.
15	15.	15.	15.	15.	32022.	9524.	9543.	24557.	39748.	4054.	2985.	1074.
16	12.	12.	12.	12.	12.	25592.	7129.	7105.	18209.	32395.	3211.	2239.
17	9.	9.	9.	9.	9.	9.	18945.	5332.	4843.	14535.	26409.	2408.
18	6.	6.	6.	6.	6.	6.	6.	13995.	3670.	3773.	11617.	21390.

5+ wgt

165093.4	142241.4	132730.2	121210.9	108913.6	91251.7	72593.9	58317.0	41603.3	34756.0	27410.0	18293.4	
No.	544027.	456506.	424934.	374298.	312837.	257405.	202477.	162255.	114441.	96529.	75977.	50818.

F.

0.014	0.016	0.015	0.009	0.012	0.057	0.047	0.202	0.056	0.077	0.224
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NATURAL MORTALITY- 0.20

ASSUMED FISHING MORTALITY FOR LAST AGE = 0.20

ESTIMATED POPULATION FOR LAST YEAR

6.	6.	6.	6.	6.	6.	6.	946.	880.	400.	2863.	5096.
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PREDETERMINED FISHING MORTALITY USED FOR LAST YEAR

0.20000
0.20000
0.20000
0.20000
0.20000
0.20000
0.20000
0.20000
0.20000
0.20000
0.20000
0.18000
0.15000
0.10000
0.05000
0.03000
0.01000

AGE	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977
2	12679.	40729.	136079.	40294.	558394.	103686.	8738.	7626.	14805.	19609.	34106.	1441.
3	36565.	10379.	33345.	111320.	32797.	454119.	84890.	6788.	6052.	12065.	15949.	27463.
4	20422.	29767.	8496.	26974.	90137.	25436.	369018.	69262.	5470.	4854.	9018.	12161.
5	49166.	16459.	24105.	6771.	20704.	73448.	20570.	296401.	56015.	4456.	3499.	6494.
6	53079.	39755.	13427.	19298.	5235.	16457.	59601.	16162.	228001.	45678.	3381.	2655.
7	71659.	41704.	32313.	10875.	15511.	4073.	13212.	48068.	12083.	181652.	36004.	2464.
8	32166.	55099.	31087.	25941.	8743.	12523.	3199.	9967.	36754.	9761.	141114.	26923.
9	8442.	24482.	42671.	24338.	20839.	6941.	9975.	2431.	6975.	29393.	7779.	101571.
10	6270.	5469.	18990.	32879.	19055.	16167.	5600.	7715.	720.	5272.	23734.	5678.
11	6195.	4847.	3783.	15168.	26586.	14739.	12951.	4463.	5588.	537.	4192.	16865.
12	32.	4605.	3669.	2915.	12219.	21079.	3669.	11807.	10323.	3229.	4166.	2979.
13	25.	25.	3284.	2925.	2292.	9592.	17050.	9411.	7476.	2406.	3313.	303.
14	20.	20.	20.	2561.	2353.	1680.	7729.	13755.	6814.	5574.	1913.	2354.
15	15.	15.	15.	15.	2030.	1841.	1316.	6205.	10550.	5080.	4431.	1359.
16	12.	12.	12.	12.	12.	1523.	1481.	1019.	4652.	8239.	4039.	3149.
17	9.	9.	9.	9.	9.	9.	1206.	1186.	629.	3568.	6650.	2869.
18	6.	6.	6.	6.	6.	6.	6.	946.	880.	400.	2863.	5096.

5+	Wt.	61450.6	54337.1	50170.7	43610.3	42133.7	52505.6	49621.8	112540.4	104689.1	86706.6	71842.6	56652.8
	No.	227095.	192506.	173389.	143712.	135594.	180079.	165703.	428051.	380367.	306182.	243338.	180758.
	F.	0.055	0.054	0.036	0.024	0.040	0.016	0.030	0.077	0.032	0.044	0.134	

F=0.35

STOCK PROJECTION AREA KLMN AUTUMN SPAWNERS '000

NATURAL MORTALITY# 0.2000 YEAR 1977

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.
2	111.	1.	0.010	0.112	12.4	0.1	90.0
3	187.	5.	0.030	0.162	30.3	0.8	148.6
4	874.	61.	0.081	0.205	179.2	12.5	659.9
5	1284.	120.	0.130	0.249	269.9	29.9	779.3
6	2204.	330.	0.180	0.253	557.6	83.5	1507.2
7	4156.	685.	0.200	0.291	1209.4	199.3	2785.9
8	2445.	403.	0.200	0.299	731.1	120.5	1638.9
9	1347.	222.	0.200	0.302	406.8	67.0	902.9
10	595.	98.	0.200	0.313	186.2	30.7	398.8
11	595.	98.	0.200	0.383	227.9	37.5	398.8
12	1195.	197.	0.201	0.383	457.7	75.5	800.2
13	4004.	660.	0.200	0.383	1533.5	252.8	2684.0
14	6085.	1003.	0.200	0.383	2330.6	384.1	4078.9
15	27030.	4469.	0.201	0.383	10352.5	1711.6	18100.7
TOTAL	51912.	8352.			18485.0	3005.9	34974.2

X.99 = 2975.8

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.
2	2795.	50.	0.020	0.112	313.0	5.6	2242.8
3	90.	4.	0.050	0.162	14.6	0.6	70.1
4	149.	18.	0.140	0.205	30.5	3.6	105.8
5	660.	123.	0.230	0.249	164.3	30.7	429.3
6	779.	194.	0.320	0.253	197.2	49.2	463.3
7	1507.	406.	0.350	0.291	438.6	118.1	869.6
8	2786.	750.	0.350	0.299	833.0	224.2	1607.3
9	1639.	441.	0.350	0.302	495.0	133.2	945.6
10	903.	243.	0.350	0.313	282.6	76.1	520.9
11	399.	107.	0.350	0.383	152.8	41.1	230.1
12	399.	107.	0.350	0.383	152.8	41.1	230.1
13	800.	215.	0.350	0.383	306.5	82.5	461.7
14	2684.	723.	0.350	0.383	1028.0	276.7	1548.5
15	22180.	5971.	0.350	0.383	8494.8	2286.9	12796.5
TOTAL	37769.	9353.			12903.4	3369.9	22521.5

X.99 = 3336.2 mt.

-17-

F=0.35

NATURAL MORTALITY# 0.2000 YEAR 1977

AGE	POP. NO. %X10-3<	CATCH NO. %X10-3<	FISHING MORT.	MEAN WT. KG.	POP. WT. %METRIC TONSK	CATCH WT. %METRIC TONSK	RESIDUAL POP. NOS.
2	144.	1.	0.008	0.121	17.4	0.1	117.0
3	2746.	74.	0.031	0.161	442.1	11.9	2179.6
4	1216.	54.	0.051	0.219	266.3	11.8	946.1
5	649.	56.	0.100	0.234	151.9	13.1	480.8
6	266.	34.	0.152	0.265	70.5	9.0	187.1
7	246.	37.	0.181	0.270	66.4	10.0	168.1
8	2692.	444.	0.201	0.286	769.9	127.0	1802.7
9	10157.	1674.	0.200	0.310	3148.7	518.9	6808.5
10	568.	94.	0.201	0.315	178.9	29.6	380.4
11	1687.	278.	0.200	0.364	614.1	101.2	1130.8
12	298.	49.	0.200	0.364	108.5	17.8	199.8
13	30.	5.	0.203	0.364	10.9	1.8	20.0
14	235.	39.	0.202	0.364	85.5	14.2	157.2
15	1247.	206.	0.201	0.364	453.9	75.0	835.1
TOTAL	22181.	3045.			6385.0	941.5	15413.0

63,850

NATURAL MORTALITY# 0.2000 YEAR 1978

AGE	POP. NO. %X10-3<	CATCH NO. %X10-3<	FISHING MORT.	MEAN WT. KG.	POP. WT. %METRIC TONSK	CATCH WT. %METRIC TONSK	RESIDUAL POP. NOS.
2	990.	18.	0.020	0.121	119.8	2.2	794.4
3	117.	5.	0.050	0.161	18.8	0.8	91.1
4	2180.	170.	0.090	0.219	477.3	37.3	1630.9
5	946.	142.	0.180	0.234	221.4	33.2	647.0
6	481.	100.	0.260	0.265	127.4	26.6	303.5
7	187.	47.	0.320	0.270	50.5	12.6	111.2
8	168.	45.	0.350	0.286	48.1	12.9	97.0
9	1803.	485.	0.350	0.310	558.8	150.4	1040.1
10	6808.	1833.	0.350	0.315	2144.7	577.4	3928.1
11	380.	102.	0.350	0.364	138.5	37.3	219.4
12	1131.	304.	0.350	0.364	411.6	110.8	652.4
13	200.	54.	0.350	0.364	72.7	19.6	115.2
14	20.	5.	0.350	0.364	7.3	2.0	11.6
15	992.	267.	0.350	0.364	361.2	97.2	572.5
TOTAL	16403.	3578.			4758.0	1120.2	10214.5

18-

x.99 = 11090.0 mt

F=0.45

STOCK PROJECTION AREA KLMN AUTUMN SPAWNERS '000

NATURAL MORTALITY# 0.2000 YEAR 1977

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.
2	111.	1.	0.010	0.112	12.4	0.1	90.0
3	187.	5.	0.030	0.162	30.3	0.8	148.6
4	874.	61.	0.081	0.205	179.2	12.5	659.9
5	1084.	120.	0.130	0.249	269.9	29.9	779.3
6	2204.	330.	0.180	0.253	557.6	83.5	1507.2
7	4156.	685.	0.200	0.291	1209.4	199.3	2785.9
8	2445.	403.	0.200	0.299	731.1	120.5	1638.9
9	1347.	222.	0.200	0.302	406.8	67.0	902.9
10	595.	98.	0.200	0.313	186.2	30.7	398.8
11	595.	98.	0.200	0.383	227.9	37.5	398.8
12	1195.	197.	0.201	0.383	457.7	75.5	800.2
13	4004.	660.	0.200	0.383	1533.5	252.8	2684.0
14	6085.	1003.	0.200	0.383	2330.6	384.1	4078.9
15	27030.	4469.	0.201	0.383	10352.5	1711.6	18100.7
TOTAL	51912.	8352.			18405.0	3005.9	34974.2

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.
2	2795.	50.	0.020	0.112	313.0	5.6	2242.8
3	90.	6.	0.070	0.162	14.6	0.9	68.7
4	149.	14.	0.110	0.205	30.5	2.9	109.0
5	660.	123.	0.230	0.249	164.3	30.7	429.3
6	779.	205.	0.340	0.253	197.2	51.8	454.1
7	1507.	463.	0.410	0.291	438.6	134.6	819.0
8	2786.	922.	0.450	0.299	833.0	275.6	1454.3
9	1639.	542.	0.450	0.302	495.0	163.8	855.6
10	903.	299.	0.450	0.313	282.6	93.5	471.4
11	399.	132.	0.450	0.383	152.8	50.5	208.2
12	399.	132.	0.450	0.383	152.8	50.5	208.2
13	800.	265.	0.450	0.383	306.5	101.4	417.8
14	2684.	888.	0.450	0.383	1028.0	340.1	1401.2
15	22180.	7339.	0.450	0.383	8494.8	2810.8	11578.8
TOTAL	37769.	11379.			12903.4	4112.9	20718.2

x.99 = 4071.8 mt.

F=0.45

STOCK PROJECTION AREA KLMN SPRING SPAWNERS '00.0

NATURAL MORTALITY# 0.2000		YEAR 1977						
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.	
2	144.	1.	0.008	0.121	17.4	0.1	117.0	
3	2746.	74.	0.031	0.161	442.1	11.9	2179.6	
4	1216.	54.	0.051	0.219	266.3	11.8	946.1	
5	649.	56.	0.100	0.234	151.9	13.1	480.8	
6	266.	34.	0.152	0.265	70.5	9.0	187.1	
7	246.	37.	0.181	0.270	66.4	10.0	168.1	
8	2692.	444.	0.201	0.286	769.9	127.0	1802.7	
9	10157.	1674.	0.200	0.310	3148.7	518.9	6808.5	
10	568.	94.	0.201	0.315	178.9	29.6	380.4	
11	1687.	278.	0.200	0.364	614.1	101.2	1130.8	
12	298.	49.	0.200	0.364	108.5	17.8	199.8	
13	30.	5.	0.203	0.364	10.9	1.8	20.0	
14	235.	39.	0.202	0.364	85.5	14.2	157.2	
15	1247.	206.	0.201	0.364	453.9	75.0	835.1	
TOTAL	22181.	3045.			6385.0	941.5	15413.0	

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.	
2	990.	18.	0.020	0.121	119.8	2.2	794.4	
3	117.	7.	0.070	0.161	18.8	1.2	89.3	
4	2180.	206.	0.110	0.219	477.3	45.1	1598.6	
5	946.	177.	0.230	0.234	221.4	41.4	615.4	
6	481.	126.	0.340	0.265	127.4	33.5	280.2	
7	187.	57.	0.410	0.270	50.5	15.5	101.6	
8	168.	56.	0.450	0.286	48.1	15.9	87.7	
9	1803.	596.	0.450	0.310	558.8	184.9	941.1	
10	6808.	2253.	0.450	0.315	2144.7	709.7	3554.3	
11	380.	126.	0.450	0.364	138.5	45.8	198.6	
12	1131.	374.	0.450	0.364	411.6	136.2	590.3	
13	200.	66.	0.450	0.364	72.7	24.1	104.3	
14	20.	7.	0.450	0.364	7.3	2.4	10.5	
15	992.	328.	0.450	0.364	361.2	119.5	518.0	
TOTAL	16403.	4398.			4758.1	1377.3	9484.4	

47581

x.99 = 13635.3mt.

17,700

F=0.45

STOCK PROJECTION AREA KLMN SPRING SPAWNERS '00.0

NATURAL MORTALITY# 0.2000 YEAR 1977

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.
2	144.	1.	0.008	0.121	17.4	0.1	117.0
3	2746.	74.	0.031	0.161	442.1	11.9	2179.6
4	1216.	54.	0.051	0.219	266.3	11.8	946.1
5	649.	56.	0.100	0.234	151.9	13.1	480.8
6	266.	34.	0.152	0.265	70.5	9.0	187.1
7	246.	37.	0.181	0.270	66.4	10.0	168.1
8	2692.	444.	0.201	0.286	769.9	127.0	1802.7
9	10157.	1674.	0.200	0.310	3148.7	518.9	6808.5
10	568.	94.	0.201	0.315	178.9	29.6	380.4
11	1687.	278.	0.200	0.364	614.1	101.2	1130.8
12	298.	49.	0.200	0.364	108.5	17.8	199.8
13	30.	5.	0.203	0.364	10.9	1.8	20.0
14	235.	39.	0.202	0.364	85.5	14.2	157.2
15	1247.	205.	0.201	0.364	453.9	75.0	835.1
TOTAL	22181.	3045.			6385.0	941.5	15413.0

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.
2	990.	18.	0.020	0.121	119.8	2.2	794.4
3	117.	7.	0.070	0.161	18.8	1.2	89.3
4	2180.	206.	0.110	0.219	477.3	45.1	1598.6
5	946.	177.	0.230	0.234	221.4	41.4	615.4
6	481.	126.	0.340	0.265	127.4	33.5	280.2
7	187.	57.	0.410	0.270	50.5	15.5	101.6
8	168.	56.	0.450	0.286	48.1	15.9	87.7
9	1803.	596.	0.450	0.310	558.8	184.9	941.1
10	6808.	2253.	0.450	0.315	2144.7	709.7	3554.3
11	380.	126.	0.450	0.364	138.5	45.8	198.6
12	1131.	374.	0.450	0.364	411.6	136.2	590.3
13	200.	66.	0.450	0.364	72.7	24.1	104.3
14	20.	7.	0.450	0.364	7.3	2.4	10.5
15	992.	328.	0.450	0.364	361.2	119.5	518.0
TOTAL	16403.	4398.			4758.1	1377.3	9484.4

47581

x.99 = 13635.3mt.

17,700