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An examination of the status of the West Coast herring stock with a re-evaluation of the historical data base

by

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[1] This series documents the scientific basis for fisheries management advice in Atlantic Canada. As such, it addresses the issues of the day in the timeframes required and the Research Documents it contains are not intended as definitive statement on the subjects addressed but rather as progress reports on ongoing investigations.

Abstract

Catches from the Newfoundland West Coast herring stock fell from 19,100 t in 1980 to 13,200 t in 1981 with a reduction in catch occurring in all gear components. The catches from both spawning groups are dominated by age group 11+ with the only change in the age frequency distribution from 1980 being an increased contribution from the 1977 year-class by both spawning groups. Due to the predominance of old fish in the autumn-spawning component the values of natural mortality were re-examined. An analysis of the percent of each spawning type in the stock by year and the level of mortality occurring in the historical period indicated that M for autumn-spawners was lower than for spring-spawners. The best agreement between the available data base and the cohort output was achieved with an M = 0.20 for spring-spawners and 0.10 for the autumn-spawners. Due to changes in the fishing pattern the effort series were not useful in calibrating the cohort. Terminal F was selected using a series of Paloheimo - and catch curve calculations which indicate an F in 1981 of 0.35. The results of cohort analysis show a continued decline in the stock with no evidence of significant recruitment occurring in recent years.

Résumé

Le stock de harengs de la côte ouest de Terre-Neuve a donné, en 1981, des prises inférieures à celles de 1980, soit 13 200 t comparativement à 19 100 t. Tous les engins de pêche ont connu une réduction. Le groupe d'âge 11+ domine encore les deux groupes de reproducteurs, le seul changement dans la distribution des fréquences d'âge par rapport à 1980 étant une plus forte contribution de la classe d'âge de 1977 chez les deux groupes de reproducteurs. A cause d'une prédominance de poissons âgés chez les reproducteurs d'automne, nous avons jugé bon de réexaminer les données sur la mortalité naturelle. Une analyse du pourcentage de chaque type de reproducteurs, par année, et le niveau de mortalité dans la série historique indiquent que M, chez les reproducteurs d'automne, est plus faible que chez les reproducteurs de printemps. On obtient le meilleur accord entre les données disponibles et l'analyse des cohortes avec un M de 0,20 pour les reproducteurs de printemps et de 0,10 pour les reproducteurs d'automne. Par suite de changements dans les habitudes de pêche, l'analyse des cohortes n'a pu être calibrée à l'aide de la série sur l'effort. Un F de dernière année a été établi d'après des calculs selon Paloheimo - et une courbe de capture indiquant un F de 0,35 en 1981. L'analyse des cohortes indique un déclin continu du stock sans qu'il y ait signe d'un recrutement significatif ces dernières années.

Introduction

Formal assessments of the Newfoundland west coast herring stock have been performed since 1977. During this period, catches increased from 12,300 t in 1977 to 19,100 t in 1980, then fell in 1981 to 13,200 t (Table 1). A reduction in catch occurred in three of the four statistical areas with only Area M showing an increased catch. Both gear components experienced a decline but it was greatest in the fixed gear sector which fell from 9,500 t in 1980 to 5,400 t in 1981 (Table 2). The most severe decrease was experienced in the most northerly area (Area N) in the gillnet fishery which took only 1,600 t in 1981.

The reduction in catch is partially attributable to the management scheme instituted in 1981. The 1981 TAC of 16,000 t, a reduction of 2,000 t from 1980, was partitioned by gear and area with all gears under quota. The breakdown of the quota and the associated 1981 catches are shown in Table 3. With the exception of the Port-au-Port Bay (Fig. 1) purse-seine quota, no quota was reached. The largest shortfalls occurred in the spring purse-seine fishery in St. George's Bay and in the northern gillnet fishery. The purse-seine fleet reported large schools of herring present in both Port-au-Port and St. George's Bays, however while the Port-au-Port schools were composed of large herring, the St. George's Bay schools were reported to be composed primarily of small herring. The lack of marketable-sized herring in St. George's Bay resulted in the shortfall in the quota. The shortfall in the gillnet fishery occurred primarily due to low abundance of herring during the summer fishery.

As in past years, the shortfall in the spring purse-seine fishery was transferred to the fall fishery. This in effect increased the shortfall for this fishery. The fleet reported that herring abundance in this area was variable but reported an abundance of herring in 4S around Great Mecatina Island which is not encompassed by the west coast management area. A tagging experiment was conducted in December 1981 in the Mecatina area in hopes of elucidating the relationship of this school to the west coast stock (Moores and Lilly 1982).

Compilation of Assessment Data:

(a) Numbers-at-age: Samples were collected from the commercial fisheries in each of the four statistical areas encompassed by the west coast stock. Numbers-at-age in the catch were calculated separately by gear and area for each month then combined to give total removals by age from the stock for each year (Table 4). The catch matrix presented in this document is slightly modified from those presented in previous assessments due to a complete re-analysis of the partioning of the catch into numbers-at-age.

(b) Age Frequency in the Catch: The age composition of the catch in 1981 was very similar to that observed in 1980 (Fig. 2). Among the spring-spawning component age-group 11+ was dominant followed by the 1974 year-class. In

the autumn-spawning component age-group 11+ remained dominant followed by the 1973 year-class.

The only significant change from 1980 is the increased contribution of the 1977 year-class which contributed moderately to the catch of both spring- and autumn-spawners. This year-class appeared most strongly in the spring fishery.

(c) Weight-at-age: Average weight-at-age values were derived separately for each spawning component from first and second quarter sampling data with data from all gears being combined. Values were generated separately for each year (see appendices).

(d) Partial Recruitment Rates: As was performed in the previous assessment (Moores et al., 1981), partial recruitment rates were examined using a comparison of the percent-at-age in the total catch to that observed in (1) spring research gillnet survey, (2) the spring and fall purse-seine fishery, and by examining the values derived from the F matrix produced in trial runs of cohort analysis. The analysis did not indicate any major changes in partial recruitment during 1981 therefore the values used were the same as those used in the previous assessment (Table 5).

(e) CPUE and Effort Data: Catch rate data were available from two sources: purse-seine log records and gillnet sales slip records. The purse-seine log records (Table 6) show a decline in catch rate from 1980 to 1981 and in both cases are the lowest on record. The catch rates in recent years may, however, be biased due to the influence of fleet efforts to fish to market requirements.

Gillnet data were available from sales slips covering the period 1977 to 1981. Catch rates (catch/landing) were calculated by month for each of the four statistical areas (Table 7). To analyze these data more fully, the months corresponding to the main fishing season (ie., April-May in Areas K and L) were selected and adjusted for changes in gang size (Table 8). The adjustment from 1977 to 1980 correspond to those derived from data on the east coast of Newfoundland (Wheeler and Winters 1981) with the 1981 adjustment factor being derived by assuming that gang size increased by the average increase from 1977-80. This adjustment is felt to be reasonable as reports from fisheries officers indicate a continuing trend of increased number of nets fished per fisherman.

An examination of the seasonal catch rates by area is ambiguous with one of the two spring fisheries showing an increase in CPUE from 1980 to 1981 while the other shows a decrease with a similar situation occurring in the fall data. When the CPUE's are combined by season a clear trend of declining CPUE can be seen. As both the spring and fall fisheries are

predominantly spring-spawners, the two catch rates were combined to give an overall index for the entire stock area.

Although the gillnet data were felt to be more reliable than the purse-seine data, it is of insufficient duration to permit an examination of the historical time period. The gillnet data were, therefore, used in conjunction with the fall purse-seine CPUE series to expand the time period covered (Table 9).

Natural Mortality Rate:

In previous assessments of this stock the natural mortality rate has generally been assumed to be 0.20. However, the general applicability of this mortality rate to both components has been questioned due to the predominance of old fish (age-group 11+) in the autumn spawning component. Indeed in a previous assessment a value of 0.15 was used for M in the autumn-spawning component (Moores, 1979). When an M = 0.20 is used for both spawning components a marked reversal of spawning type occurs (Moores and Winters, 1977). From 1966 to 1972, the 5+ population is predominantly autumn-spawners (up to 80%), but since 1973 spring-spawners, through the recruitment of the 1968 year-class, has dominated and now represents 80% of the population. The large numbers of autumn-spawners produced by cohort analysis in the early years is at odds with the catch matrix (Table 4) which shows spring-spawners as the main contributor to the catch even in the early years.

This anomaly would appear to indicate that the size of the autumn-spawning component is being overestimated by the cohort analysis. This may in part be a result of the use of the same level of M for both components of the stock. Such a contention is not supported by the age composition of the catch which suggests that the autumn component is longer lived than spring-spawners thereby indicating a lower level of natural mortality for autumn-spawners. A lower level of M for autumn-spawners would also be biologically plausable as autumn-spawners are slower growing and later maturing than spring-spawners and due to the differences in time and location of spawning the two components are separate for large portions of the year thereby enhancing the potential for differential mortality rates to occur.

The impact of natural mortality on the catch-cohort relationship was examined using the percentage spawning type composition of the fall purse seine fishery as an index of stock composition. This fishery was felt to be most indicative of the total stock as it represents the exploitation of the stock during the period of greatest intermix using a non-selective gear. As the age composition of the spring-spawning component is similar to that of other herring stocks in the Atlantic area M was assumed to be 0.20 while for autumn spawners three options of M were used (M = 0.20, 0.15 and 0.10). Runs were also performed at various levels of F_T to see if this was also a contributor to the anomaly. The results (Table 10) show that the proportion of spring-spawners observed in the fall fishery was most closely paralleled when the

natural mortality rate of autumn-spawners was at 0.10, while the values seen at M = 0.20 were markedly different with those at M = 0.15 being intermediate.

The effect of changing M from 0.20 to 0.10 for the autumn-spawning component was further examined by comparing the relationship of CPUE to biomass (5+) and effort to F (5+) under the two options of M. The CPUE and effort data used were based on the combined gillnet - purse-seine data. Examples of the results obtained at F_T = 0.30 are shown in Fig. 3 and 4. Under both options of M the data fall into two groups, one for the historical period 1966-73 and the recent period 1978-81. Insufficient data are available for the recent period to adequately assess whether the cause of the two groupings is appropriately assigned to changes in M or catchability.

As the fishery during the early period was relatively small, catch curves and weighted Paloheimo Z values were calculated for the 1966-73 period in hopes of gaining insight into the mortality rates occurring during this period. Catch curves were constructed using combined year-classes (i.e., 5+ in 1966, 6+ in 1967, etc.) and gave average Z values of 0.40 for spring-spawners (r^2 = 0.92) and 0.48 for autumn-spawners (r^2 = 0.87). Weighted Paloheimo Z values over the period 1966-73 were calculated to be 0.33 for the spring-spawners and 0.27 for autumn-spawners. These analysis indicate that during this period the level of F on autumn-spawners was roughly in the order of one-half or equal to the level of F exerted on spring-spawners. A comparison of the levels of F generated by cohort analysis under two options of M (Table 11) shows that a similar relationship between F's occurs at M = 0.10 for autumn-spawners while under the condition that M = 0.20 for both components the resultant F values for autumn-spawners are low.

In all cases however the Z values were higher than those generated by cohort analysis for the historical period. This problem may in part be due to the overlap of the west coast and southern Gulf of St. Lawrence stocks in the 1960's as was demonstrated by tagging experiments reported by Winters and Parsons (1972). This overlap may have led to exploitation of the west coast stock in areas not currently encompassed by the west coast stock area. Under such a condition the catch matrix would not account for all removals from the stock resulting in an underestimation of F in the early years of the cohort analysis.

While there are potential biases in the data base available for this stock the above analyses consistently indicate that the natural mortality rate on autumn-spawners is lower than for spring-spawners. If the current assumed level of M for this herring stock (M = 0.20) is applied to the spring-spawning component then the level of M for autumn-spawners must be less than 0.20. The above analyses indicate that the best agreement between the spawning type composition in the stock and from cohort and the relative level of mortality was achieved when the natural mortality rate on autumn-spawners was 0.10. The natural mortality rates used for the subsequent analysis of this stock, therefore, were 0.20 for spring-spawners and 0.10 for autumn-spawners.

It should be pointed out that these values of M are used to rationalize the data base with known information and the values are not presented as absolutes. In fact, the effect on the catch projections in this particular use is not significant whether one uses M = 0.10 or M = 0.2 for autumn-spawners.

Calculation of Terminal F:

As can be seen from Fig. 3 and 4, the cohort analysis cannot be fine-tuned using the traditional analyses of CPUE and biomass or F and effort due to the breakdown of the data into two time periods with only four points in the recent time period. Therefore, the mortality rate in the recent period was examined using the method of Paloheimo and through catch curves. The various permutations examined and the resultant Z values are given in Table 12. The data can be roughly broken into two groups based on the catch data used: purse-seine and gillnet. The gillnet data gave either high or low Z values and were felt to be unreliable. The selection of F_T was, therefore, restricted to the purse-seine data. Within the spring-spawners F_T varied from 0.20 to 0.45 but fell most consistantly at 0.35. The PZ values generated for autumn-spawners gave no clear indication as to which PZ value was most appropriate. As a result an average Z value for autumn-spawners was derived by taking an average of the Z values generated in the cases which produced an $F_T = 0.35$ for spring-spawners. This gave an average Z for autumn-spawners of 0.22 which were generated at $F_T = 0.15$ in 1981.

Based on these analyses the F_T values used for the final cohort runs were 0.35 for spring-spawners and 0.15 for autumn-spawners.

Results of the Assessment:

(a) Trends in Biomass and F: The autumn-spawning component has shown a decline in population numbers (Table 13) and biomass (Table 14) from 1966 to 1981 with a slight bump occurring in 1971. The 5+ biomass of this component has declined from 141.1 x 10^3 t in 1966 to 16.9 x 10^3 t in 1981 (Table 14). Among the spring-spawners biomass (5+) peaked in 1974 with the recruitment of the 1968 and 1969 year-classes and has since declined. Peak biomasses of 143.3 x 10^3 t was observed in 1974 and has declined to 38.3 x 10^3 t in 1981. Within the total stock 5+ biomass from 1966-81 was highest in 1974 at 230.3 x 10^3 t and in 1981 was at the lowest level during the time series at 55.2 x 10^3 t.

During the period 1966-75 fishing mortalities on this stock were low for both spawning components (Table 14). This, however, as has been mentioned previously, may be biased downward due to exploitation of this stock in areas other than the west coast. Since 1976 the fishing mortality has risen steadily for spring-spawners while the mortality on autumn-spawners peaked in 1979 and has subsequently declined. The increase in F coincides with the expansion in the fishery which has occurred since 1975.

(b) Trends in Recruitment: During this time period covered by the analysis (1966-81), recruitment to the autumn-spawning component has been poor (Table 13). Only twice has recruitment exceeded 2.0 x 10^6 individuals and in both cases these year-classes were not significant. This trend of low

recruitment has led to a decline in this component from 546.9 x 10^6 individuals (2+) in 1966 to 79.8 x 10^6 individuals in 1981.

The recruitment pattern among spring-spawners has been better than among the autumn-spawners. The largest year-class observed has been the 1968 year-class with 715.7 x 10^6 individuals at age 2. Since that time the strongest year-class has been the 1974 year-class which is 1/5 the strength of the 1968 year-class. The abundance of the spring-spawning component has declined from 1086.2 x 10^6 individuals (2+) in 1971 to 120.4 x 10^6 individuals in 1981.

In spite of the apparent trend of poor recruitment, reports were received in 1981 that young herring were again abundant along the west coast particularly in St. George's Bay. Young herring were also reported in the Bay of Islands and Bonne Bay areas. The strength of these recent year-classes has yet to be determined but provide the only optimistic note in an otherwise bleak stock outlook for the near future.

Catch Projection:

(a) Partial Recruitment Rates: The partial recruitment rates used for the projection were the same as those used for cohort analysis and remain unchanged from last year (Table 5).

(b) Average weight-at-age: The average weight-at-age data used in the projection were average values observed in the first and second quarters of the 1981 fishery (Table 5) and are not an average of several years as was done in the previous assessment.

(c) Calculation of $F_{0.1}$: Due to change in average weight-at-age data the $F_{0.1}$ level was recalculated using the data in Table 10 for ages 2-11, with $M = 0.20$ for spring-spawners and 0.10 for autumn-spawners. These calculations gave $F_{0.1}$ levels of 0.405 and 0.373 for spring- and autumn-spawners, respectively.

(d) Catch Projection: Catch projections were performed at the $F_{0.1}$ level for both spring- and autumn-spawners with an arbitrary recruitment at age 2 of 5 x 10^6 individuals. A comparison of the calculated catch in 1981 to the observed 1981 catch produced a correction factor of 1.020. The results of the projection for 1982 are:

	Spring-spawners	Autumn-spawners	Total
Projected catch (t)	8041	4453	12494
Adjusted catch (t)	8202	4542	12744

(detailed catch projections are given in the Appendices)

This projection indicates that 36% of the 1982 catch would be composed of autumn-spawners which is well above the level of 20% which has been observed in recent years. The high level of catch is attributable to the high average weight (524 gm) of the 11+ fish which form the bulk of the autumn-spawning catch and the low F_T used to calculate the population size of this component. One indication that F_T for autumn maybe higher is the percent of spring-spawners in the population generated by the above analysis where, for example, the 1981 level is 70% as compared to 82% in the fall purse-seine fishery.

In order to produce the same pattern of spawning-type composition in the stock and percentage contribution to the catch as had been observed in recent years would require that the same level of F (0.35) be applied to both spawning components in 1981. This would produce a TAC of 10,000 t in 1982. The possible overestimation of the autumn-spawning component, however, is counterbalanced by the possible underestimation of the spring-spawning component. The CPUE data used to calculate Z values are heavily influenced by the purse-seine effort in Area M+N. If the reduction in CPUE was due to absence of the fish in the area due to emmigration (i.e., to the Mecatina Island area) rather than reduced population abundance, then the CPUE index has been biased down. This would lead to an underestimation of the 1981 stock and therefore the 1982 projected catch would be too low.

Discussion

In the course of conducting this assessment, several short-comings in the data base relating to the west coast herring stock were very apparent. One of the main concerns was the historical (1966-74) data. When a natural mortality rate of 0.2 is used for both spawning components the size of the autumn-spawning component appears to be unrealistically large. This problem can be remedied by reducing M to 0.10. However, the level of fishing mortality observed under both conditions of M is underestimated if the catch curves are to be believed. An alternate explanation maybe that during the early period covered in this assessment a portion of the west coast was exploited in adjacent areas. This would produce an underestimate of removals from the stock thereby affecting the estimates of mortality. Unfortunately, there does not appear to be sufficient data to resolve this problem.

The second area of concern is that problem of devising a reliable means of fine-tuning the population models. As has been noted in previous assessments, both the purse-seine data and the gillnet data have biases although the gillnet data appear to have the most potential. While it may be possible to refine these data, what is required is an independent estimator of abundance. During the past two years, the Pelagic Section in St. John's has been conducting programs using research gillnet fleets to obtain measures of stock abundance and trawl surveys in January to obtain estimates of pre-recruits. While both studies are in their infancy, they do hold some promise as a means of increasing the reliability of assessments of this stock.

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Table 1. Newfoundland west coast herring catches (tons) 1966-81.

Year	K	L	M	N	Total catch
1966		103	5529	18	5650
1967		66	5540	13	5619
1968		59	3978	11	4048
1969		46	2549	40	2635
1970		27	3473	301	3801
1971		2424	1076	1963	5463
1972		862	1544	3628	6034
1973		2862	2067	9222	14151
1974		856	942	2842	4640
1975	3613	113	242	1027	4995
1976	6565	2067	226	1251	10109
1977	5569	2203	156	4358	12286
1978	6808	1984	365	6453	15610
1979	6032	5043	3996	3250	18321
1980	5097	6943	2967	4113	19120
1981[1]	3374	4723	3452	1672	13221

[1] provisional data.

Table 2. Herring catches (t) from the west coast Newfoundland area by gear type.

Year	K		L		M		N		Combined		Total
	Purse Seine	Inshore	Purse Seine	Inshore	Purse Seine	Inshore	Purse Seine	Inshore	Purse Seine	Inshore	
1966				103	5490	39		18	5490	160	5650
1967				66	5464	76		13	5464	155	5619
1968				59	3776	202		11	3776	272	4048
1969				46	2344	205		40	2344	291	2635
1970			12	15	2939	534		301	2951	850	3801
1971			2239	185	725	351	356	1607	3320	2143	5463
1972			727	135	1330	214	-	3628	2057	3977	6034
1973			2740	122	1763	304	3453	5769	7956	6195	14151
1974			756	100	439	503	1071	1771	2266	2374	4640
1975	3495	118	-	113	-	242	-	1027	3495	1500	4995
1976	6067	498	1955	112	-	226	184	1067	8206	1903	10109
1977	5289	280	2008	195	-	156	2167	2191	9464	2822	12286
1978	6252	556	1037	947	-	365	2636	3817	9925	5685	15610
1979	4387	1645	2773	2270	2829	1167	-	3250	9989	8332	18321
1980	3480	1617	3702	3241	2001	966	427	3686	9610	9510	19120
1981[1]	2269	1105	3115	1608	2406	1046	51	1621	7841	5380	13221

[1] provisional data.

Table 3. A comparison of catch and quotas for the Newfoundland west coast herring stock in 1981. (catches in brackets)

Area	Purse-seine	Fixed gear	Total
St. George's Bay	3600 (2269)	1300 (1105)	4900 (3374)
Port-au-Port	2700 (3115)	1750 (1608)	4450 (4723)
Cape Gregory North	2700 (2457)	3850 (2667)	6550 (5124)
TOTAL	9000 (7841)	6900 (5380)	15900 (13221)

Table 4. Removals at age ($x10^{-3}$) from the Newfoundland west coast herring stock. (SS = Spring-spawners; AS = Autumn-spawners)

	Age	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981
SS	1	0	0	0	0	0	0	372	0	0	0	0	29	0	0	4	6
	2	181	1	103	209	2999	0	375	196	62	96	511	11	0	143	320	33
	3	367	8	271	1093	1419	2922	254	96	116	738	997	664	40	30	992	390
	4	282	337	187	1502	359	271	6273	712	26	345	982	533	2097	176	85	2050
	5	547	60	483	338	557	544	734	15456	206	190	229	516	210	10967	327	135
	6	1920	268	131	314	243	257	797	1191	5596	1283	319	287	749	575	14894	332
	7	3863	3442	566	173	195	138	861	2557	129	8261	2745	346	287	1039	412	8443
	8	2018	2739	1229	439	228	249	182	1156	732	237	15428	4160	2266	456	1304	224
	9	1561	1176	2257	975	1008	98	476	1214	457	360	764	16333	8617	2710	258	570
	10	287	775	409	372	985	278	118	688	38	140	2851	926	15951	7042	991	226
	11+	475	866	433	446	1734	747	1024	3828	1740	671	3134	5547	4380	14466	21735	14286
	Total	11501	9672	6069	5861	9727	5504	11466	27094	9102	12321	27960	29352	34597	37604	41322	26695
AS	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	2	104	0	0	17	0	31	29	0	0	0	0	0	0	0	16	0
	3	181	28	226	300	890	0	102	269	12	96	59	3	15	19	215	63
	4	639	51	131	540	176	2	113	444	149	174	47	61	53	70	83	443
	5	277	529	201	279	136	54	78	669	118	1110	102	113	452	288	143	202
	6	274	306	1037	616	243	354	268	648	58	327	338	302	311	2542	253	93
	7	277	116	294	519	486	966	352	1054	125	78	470	746	1130	626	1542	216
	8	1007	322	223	158	169	2070	463	1118	58	112	108	388	1841	1396	224	833
	9	1105	927	288	122	126	1114	960	2383	208	67	158	214	589	2038	691	159
	10	926	1128	1208	164	225	723	279	2204	205	63	52	99	379	552	282	101
	11+	2781	3155	2568	1259	2140	7664	6589	10029	2237	2229	3969	7213	5681	6824	5027	2705
	Total	7571	6562	6176	3974	4591	12978	9233	18818	3170	4256	5303	9139	10451	14355	8476	4815
Total AS + SS		19072	16234	12245	9835	14318	18482	20699	45912	12272	16577	33263	38491	45048	51959	49798	31510

Table 5. Partial recruitment rates utilized in cohort analysis for spring- and autumn-spawners and average weights for 1981.

Spawning type	Age									
	2	3	4	5	6	7	8	9	10	11+
Spring-spawners PR	0.10	0.20	0.30	0.60	1.00	1.00	1.00	1.00	1.00	1.00
average weight	72	176	234	308	329	367	394	416	412	463
Autumn-spawners PR	0.01	0.05	0.10	0.20	0.50	1.00	1.00	1.00	1.00	1.00
average weight	50	126	212	257	288	368	400	436	486	524

Table 6. Effort data for the Newfoundland west coast fishery based on data from the purse-seine fleet.

Year	Catch (t)	Catch/op. day		Effort	
		K + L	M + N	K + L	M + N
1966	5650		63.2		89.4
1967	5619		67.5		86.5
1968	4048		65.4		61.9
1969	2635		47.8		55.1
1970	3801		38.3		99.2
1971	5463		38.6		141.5
1972	6034		31.7		190.4
1973	14151		53.0		267.0
1974	4640	-	-		-
1975	4995	92.6	-	53.9	-
1976	10109	89.5	-	113.0	-
1977	12286	79.8	(70.2)[1]	154.0	(175.0)[1]
1978	15610	68.5	114.7	227.9	136.1
1979	18321	73.5	54.2	249.3	338.0
1980	19120	106.5	62.9	179.5	304.0
1981	13221	68.4	24.9	193.3	531.0

[1] from landing slips

Table 7. Monthly CPUE data (unadjusted for changes in fleet size) expressed as catch per landing for each of the four statistical areas in the Newfoundland west coast area for the period 1977-81. (Number of landings in brackets)

Area	Year	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
K	1977	-	0.07 (1)	0.17 (18)	0.91 (7)	-	-	-	-	-	-
	1978	-	0.25 (68)	0.66 (422)	-	-	-	-	-	-	-
	1979	0.36 (12)	0.51 (815)	0.70 (775)	0.11 (17)	-	0.28 (2)	-	-	0.11 (2)	-
	1980	-	0.25 (68)	0.77 (426)	-	-	-	-	-	-	-
	1981	0.67 (25)	0.66 (531)	1.10 (236)	-	-	-	-	-	-	-
L	1977	-	-	0.38 (105)	-	-	-	-	-	-	-
	1978	1.18 (1)	1.35 (132)	1.15 (162)	0.13 (21)	0.08 (1)	0.08 (1)	0.54 (66)	0.88 (102)	0.34 (2)	-
	1979	0.30 (6)	1.32 (679)	1.18 (792)	0.32 (14)	0.47 (6)	0.30 (11)	0.38 (25)	0.55 (49)	0.57 (37)	-
	1980	-	1.41 (953)	1.41 (977)	1.78 (3)	-	4.61 (1)	-	0.59 (2)	-	-
	1981	0.38 (34)	0.75 (1016)	0.92 (614)	0.44 (5)	-	-	0.42 (24)	0.97 (9)	0.55 (2)	-
M	1977	-	-	0.53 (11)	-	-	-	-	-	-	-
	1978	-	-	1.08 (54)	0.70 (20)	-	-	0.30 (21)	0.53 (52)	1.06 (38)	1.00 (1)
	1979	-	0.32 (50)	0.37 (268)	0.25 (9)	0.11 (3)	0.16 (2)	0.47 (4)	0.59 (17)	0.98 (412)	0.40 (14)
	1980	-	0.57 (9)	0.45 (102)	0.43 (14)	0.41 (26)	0.71 (180)	0.61 (33)	0.73 (189)	1.30 (118)	-
	1981	-	0.33 (24)	1.09 (128)	0.23 (12)	0.69 (5)	0.25 (35)	0.20 (5)	0.99 (377)	0.54 (65)	-
N	1977	-	-	-	-	0.34 (233)	0.77 (413)	0.62 (186)	0.43 (286)	1.04 (203)	0.82 (8)
	1978	-	-	-	0.62 (66)	0.75 (701)	0.66 (338)	0.59 (453)	0.63 (343)	0.79 (136)	-
	1979	-	-	-	0.44 (78)	0.46 (580)	0.69 (554)	0.39 (290)	0.43 (180)	0.58 (436)	0.65 (115)
	1980	-	-	0.72 (21)	0.47 (290)	0.49 (1353)	0.64 (2357)	0.62 (759)	0.37 (241)	0.51 (431)	0.17 (17)
	1981	-	-	0.29 (1)	0.56 (163)	0.49 (413)	0.56 (937)	0.44 (420)	0.65 (255)	0.72 (196)	0.61 (17)

Table 8. Gillnet catch rates from the Newfoundland west coast combined for the spring and fall fisheries and over the entire area. All values are unweighted averages adjusted for increases in fleet size.

Year	Adjustment factor	Area K+L (Apr.-May)			Area M+N (Oct.-Nov.)			K+L+M+N combined
		K	L	K+L	M	N	M+N	
1977	1.00	0.12	0.38	0.25	-	0.74	0.74	(0.50)
1978	1.10	0.42	1.14	0.78	0.73	0.65	0.69	0.74
1979	1.27	0.48	0.98	0.73	0.62	0.40	0.51	0.62
1980	1.45	0.35	0.97	0.66	0.70	0.30	0.50	0.58
1981	1.60	0.55	0.52	0.54	0.48	0.43	0.46	0.50

Table 9. Combined purse-seine CPUE data including the fall purse-seine data (M+N) and the combined spring and fall gillnet fisheries. (Standardized to 1979)

Year	Purse-seine	Gillnet	CPUE index
1966	63.2	-	1.17
1967	67.5	-	1.25
1968	65.4	-	1.21
1969	47.8	-	0.88
1970	38.3	-	0.71
1971	38.6	-	0.71
1972	31.7	-	0.58
1973	53.0	-	0.98
1974	-	-	-
1975	-	-	-
1976	-	-	-
1977	-	(.50) *	-
1978	(114.7) *	.74	1.19
1979	54.2	.62	1.00
1980	62.9	.58	1.05
1981	24.9	.50	0.64

* values in brackets excluded

Table 10. Comparison of percent spring-spawners in the population at various options of F_T and of M for autumn-spawners and the percent spring-spawners in the fall purse-seine fishery. (M for SS = 0.20)

		M_{AS} = 0.10			M_{AS} = 0.15	M_{AS} = 0.20		
Year	Purse-seine	.20	.30	.40	0.30	.20	.30	.40
1966	61.7	55.5	53.9	53.0	39.6	18.8	18.7	18.9
1967	63.7	53.3	51.7	50.7	38.5	19.0	18.9	19.0
1968	50.4	50.0	48.3	47.3	36.4	19.0	18.8	18.9
1969	46.6	46.7	45.0	44.0	34.3	18.6	18.4	18.4
1970	49.2	46.7	45.1	44.2	35.5	20.2	20.0	20.1
1971	61.0	54.3	52.9	52.0	44.0	27.4	27.3	27.5
1972	55.8	55.8	54.6	53.9	46.5	29.9	29.9	30.1
1973	83.3	80.4	79.8	79.4	74.6	59.9	60.0	60.4
1974	94.5	84.2	83.6	83.2	79.4	66.7	66.6	66.8
1975	-	82.4	81.7	81.3	78.0	66.5	66.3	66.4
1976	88.2	80.9	80.1	79.6	77.0	67.0	66.9	67.1
1977	87.8	79.9	79.0	78.4	76.5	68.3	68.3	68.3
1978	83.4	78.8	77.9	77.3	75.9	68.0	67.8	67.8
1979	93.2	84.5	83.9	83.4	82.7	77.9	77.6	77.5
1980	87.7	85.6	85.5	85.4	84.7	81.8	81.9	82.0
1981	81.5	83.2	83.3	83.5	83.0	82.6	82.7	82.8

Table 11. Fishing mortalities from cohort analysis with F_T = 0.35 and M = 0.20 for spring-spawners and M = 0.20 and 0.10 for autumn-spawners.

	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981
SS (M = 0.20)	.041	.043	.029	.019	.034	.013	.026	.056	.018	.026	.076	.109	.177	.199	.339	.349
AS (M = 0.20)	.006	.007	.007	.004	.006	.027	.023	.059	.001	.019	.029	.063	.121	.327	.387	.263
(M = 0.10)	.020	.022	.020	.011	.014	.058	.047	.110	.019	.029	.042	.084	.149	.378	.419	.263

Table 12. A list of the various analyses performed to generate mortality rates in the recent years of the west coast fishery, the resultant $\bar{z}$ values and corresponding F_T level.

Method	Data used		$\bar{z}$		*F_T	
			SS	AS	SS	AS
Catch curve	M+N Purse-seine catch - combined CPUE	(a) 78-81 (5+)	0.36	0.20	0.20	<0.20
		(b) 74yc 79-81	0.47	-	0.35	
Paloheimo	M+N Purse-seine catch - combined CPUE	80-81	0.58	0.14	0.35	0.20
	M+N Purse-seine and gillnet - combined CPUE	80-81	0.58	0.30	0.35	0.20
	Total catch - combined CPUE		0.63	0.80	0.45	>0.40
Paloheimo	July-August Gillnet catch M+N - M+N gillnet CPUE	80-81	0.81	0.17	>0.40	<0.20
	Oct.-Nov. gillnet catch M+N - M+N gillnet CPUE	80-81	0.15	0.17	-	<0.20
	Apr.-May gillnet catch K+L - K+L	80-81	0.37	1.23	<0.20	-

* M assumed to be 0.20 for spring-spawners and 0.10 for autumn-spawners

Table 13 Population estimates of spring- and autumn-spawning herring from the Newfoundland west coast. F_T = 0.35 and M = 0.20 for spring-spawners, F_T = 0.15 and M = 0.10 for autumn-spawners. (SS = Spring-spawners; AS = Autumn-spawners)

	Age	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981
SS	2	119	412	1338	407	7157	2761	427	100	221	82	1489	38	16	353	81	11
	3	340	96	338	1095	331	5832	2261	346	80	180	66	1214	31	13	288	64
	4	189	275	78	274	887	259	4749	1849	283	64	141	45	988	25	11	227
	5	757	152	222	62	211	723	209	3831	1507	231	49	106	32	790	19	8
	6	787	615	124	177	48	168	587	165	2997	1232	188	38	82	24	548	12
	7	642	627	501	100	142	37	135	473	124	2403	997	151	29	61	15	314
	8	356	491	482	405	81	115	29	103	364	100	1892	791	120	21	40	8
	9	200	273	377	384	328	64	92	22	74	292	80	1410	610	78	13	21
	10	95	150	213	288	305	259	51	71	7	56	235	59	1007	422	39	8
	11+	77	134	218	345	511	644	730	630	533	426	381	444	343	908	878	531
	N_t ($\times 10^{-5}$)	3562	3225	3891	3537	10001	10862	9270	7590	6190	5066	5518	4296	3258	2695	1932	1204
AS	2	234	93	50	46	82	104	151	86	48	189	36	23	98	384	98	7
	3	411	210	84	45	41	74	94	136	78	43	171	32	21	89	348	89
	4	123	371	190	74	38	29	67	84	121	71	38	154	29	19	80	313
	5	632	106	335	171	62	33	26	59	72	108	62	34	139	26	16	72
	6	693	569	90	301	152	54	29	23	47	64	87	55	30	121	21	14
	7	780	624	512	72	267	135	46	24	14	42	55	76	47	24	86	16
	8	906	704	564	460	60	237	113	38	11	12	38	45	61	32	16	63
	9	654	810	634	508	415	53	194	98	24	10	10	33	37	38	16	12
	10	511	581	724	571	458	374	37	168	66	20	8	7	28	28	15	8
	11+	525	902	1301	1797	2128	2318	2356	2100	1935	1787	1512	1203	890	618	382	204
	N_t ($\times 10^{-5}$)	5469	4970	4484	4045	3703	3411	3113	2816	2416	2346	2017	1662	1380	1379	1078	798

Table 14. Population biomass and mortalities from cohort analysis. F_T = 0.35 and M = 0.20 for spring-spawners, F_T = 0.15 and M = 0.10 for autumn-spawners.

		1966	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981
Biomass 2+	AS	149.3	147.4	143.5	137.9	131.1	135.9	103.6	93.3	90.8	86.3	68.1	55.5	47.9	37.1	30.9	24.7
($x10^{-3}$ t)	SS	87.7	79.8	80.3	80.1	128.3	172.2	200.2	170.3	151.7	135.3	124.7	101.6	89.0	79.2	61.8	44.8
	Total	237.0	227.2	223.8	218.0	259.4	308.1	303.8	263.6	242.5	221.6	192.8	157.1	136.9	116.3	92.7	69.5
Biomass 5+	AS	141.1	138.0	139.0	135.8	129.5	134.0	100.6	89.1	87.0	83.7	65.8	52.5	46.7	33.8	24.4	16.9
($x10^{-3}$ t)	SS	78.0	69.8	63.5	55.2	51.6	58.7	56.3	128.1	143.3	130.8	110.8	85.7	71.4	75.4	56.2	38.3
	Total	219.1	207.8	202.5	191.0	181.1	192.7	156.9	217.2	230.3	214.5	176.7	138.2	118.1	109.2	80.6	55.2
F_{5-18}	AS	.015	.016	.015	.008	.011	.043	.034	.079	.013	.021	.029	.056	.096	.224	.219	.113
	SS	.041	.043	.029	.019	.034	.013	.026	.056	.018	.026	.076	.109	.177	.199	.339	.349

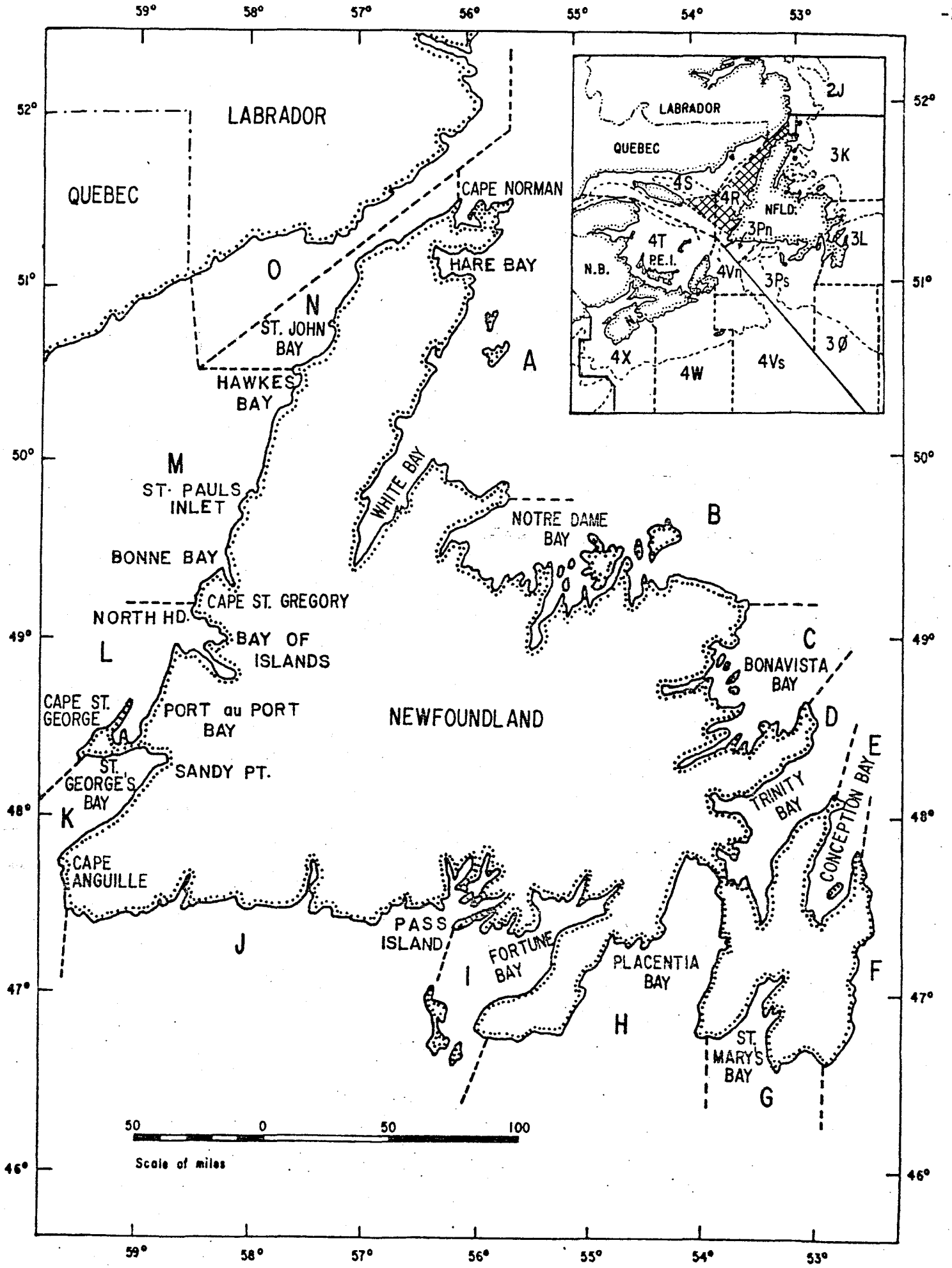

Fig. 1. Area map of Newfoundland.

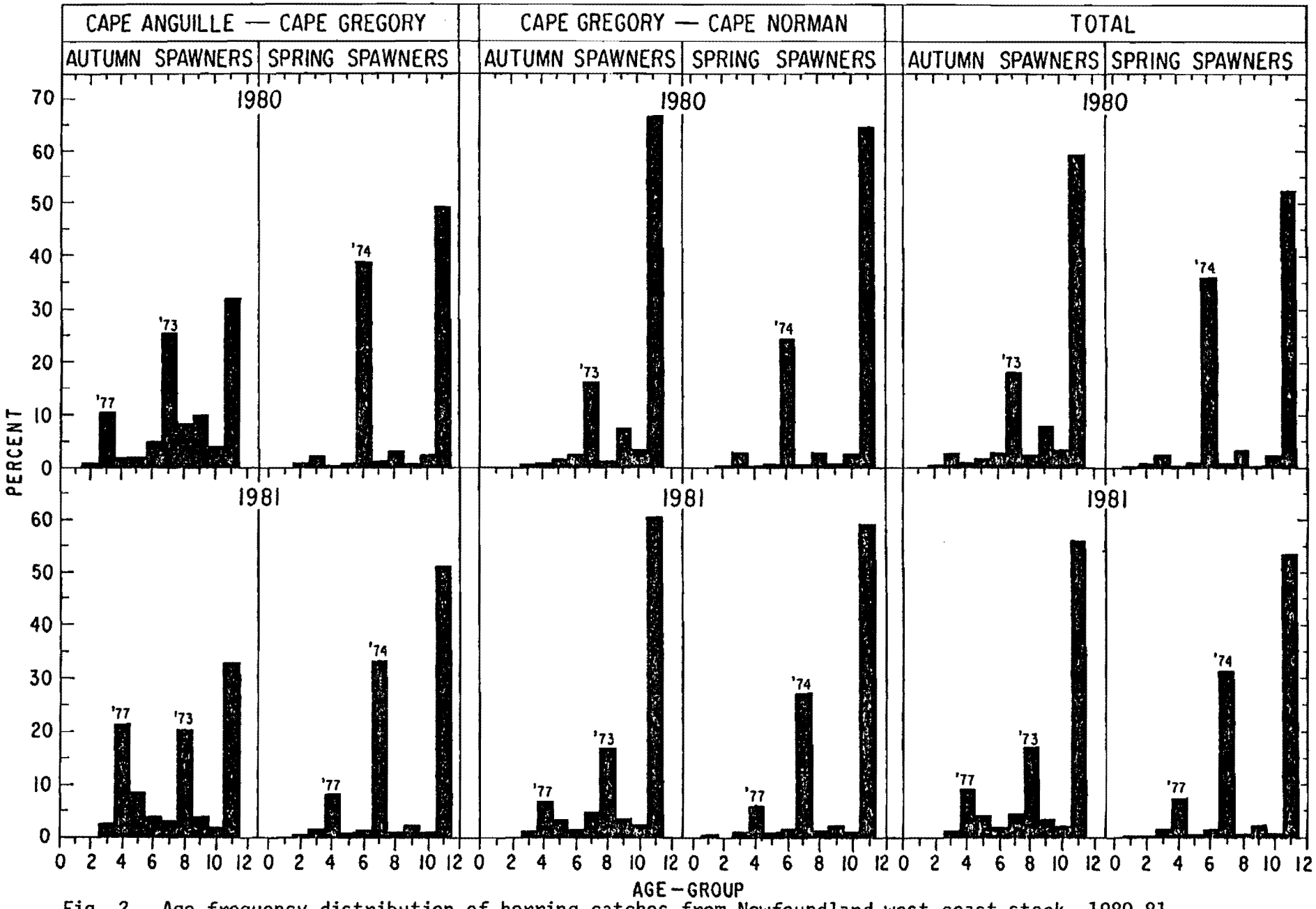

Fig. 2. Age frequency distribution of herring catches from Newfoundland west coast stock, 1980-81.

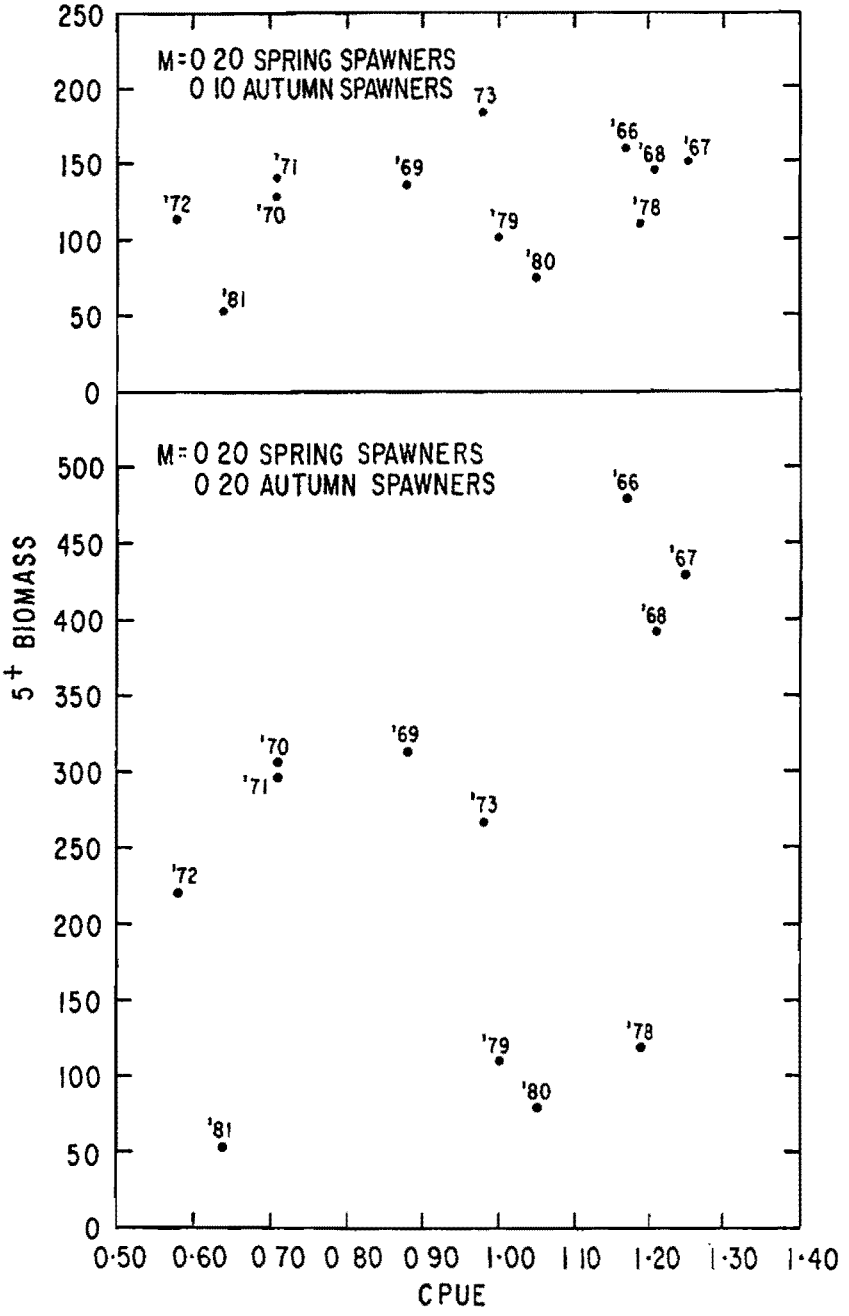

Fig. 3. Comparison of CPUE and biomass under two options of natural mortality (0.10 and 0.20) for autumn-spawners F_T = 0.30 and M of spring-spawners = 0.20.

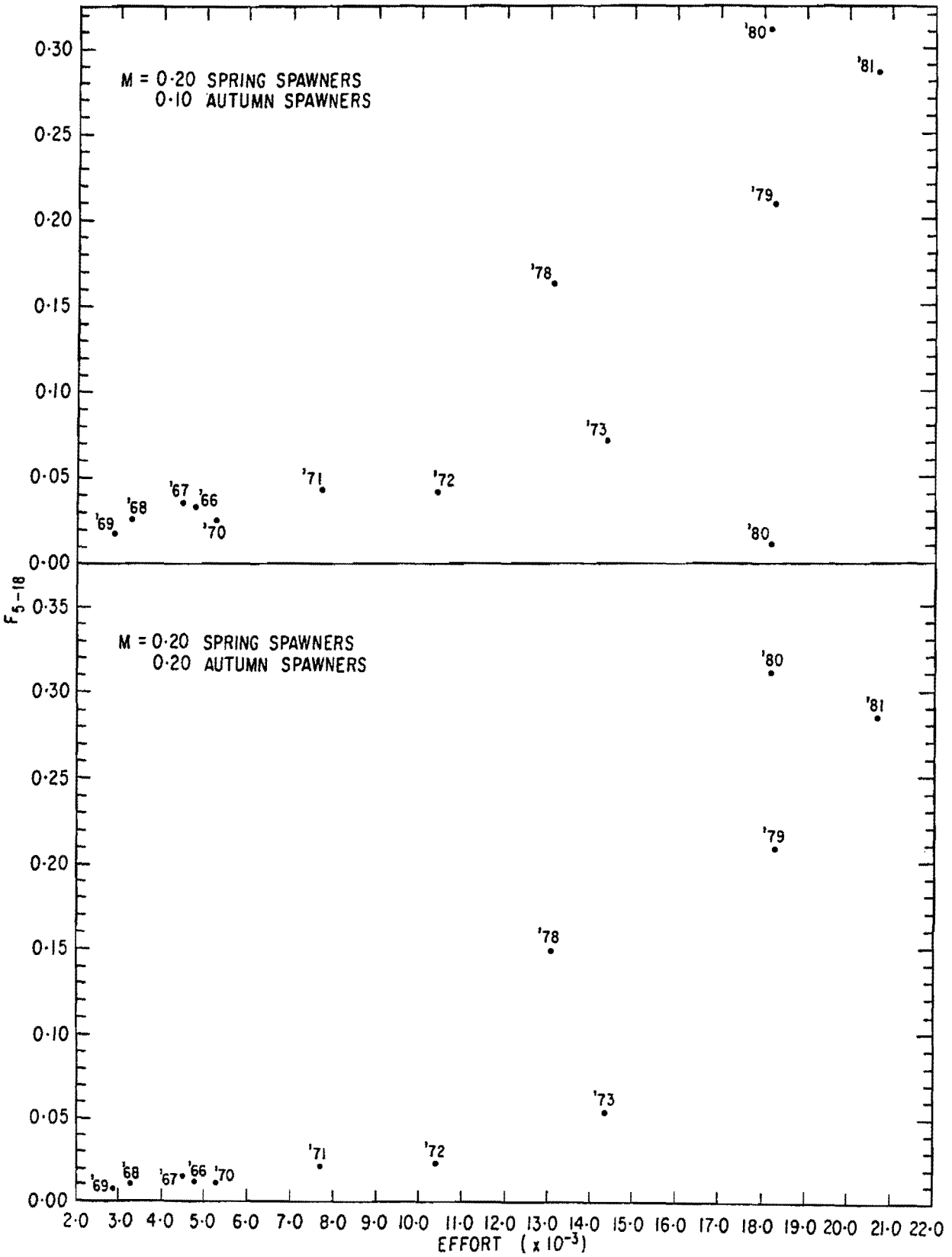

Fig. 4. A comparison of effort and F under two options of natural mortality (0.10 and 0.20) for autumn-spawners with F_T = 0.30 and M of spring-spawners = 0.20.

APPENDIX

1. Spring-spawners
   - (a) catch matrix
   - (b) weight matrix
   - (c) F matrix
   - (d) population matrix
   - (e) catch projection (i) 1982
     (ii) 1983

2. Autumn-spawners
   - (a) catch matrix
   - (b) weight matrix
   - (c) F matrix
   - (d) population matrix
   - (e) catch projection (i) 1982
     (ii) 1983

C A T C H M A T R I X SPRING - SPAWNERS

AGE/YEAR	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975
2	181.	1.	103.	209.	2999.	1.	375.	196.	62.	96.
3	367.	8.	271.	1093.	1419.	2922.	254.	96.	116.	738.
4	282.	337.	187.	1502.	359.	271.	6273.	712.	26.	345.
5	547.	60.	483.	338.	557.	544.	734.	15456.	206.	190.
6	1920.	268.	131.	314.	243.	257.	797.	1191.	5596.	1283.
7	3863.	3442.	566.	173.	195.	138.	861.	2557.	129.	8261.
8	2018.	2739.	1229.	439.	228.	249.	182.	1156.	732.	237.
9	1561.	1176.	2257.	975.	1008.	98.	476.	1214.	457.	360.
10	287.	775.	409.	372.	985.	278.	118.	688.	38.	140.
11	475.	326.	205.	217.	789.	271.	278.	396.	265.	14.
12	1.	540.	86.	109.	460.	217.	271.	932.	153.	100.
13	1.	1.	142.	46.	231.	126.	217.	908.	359.	58.
14	1.	1.	1.	74.	98.	63.	126.	727.	350.	135.
15	1.	1.	1.	1.	156.	27.	63.	422.	280.	132.
16	1.	1.	1.	1.	1.	43.	27.	211.	163.	106.
17	1.	1.	1.	1.	1.	1.	42.	91.	81.	62.
18	1.	1.	1.	1.	1.	1.	1.	141.	35.	31.
19	1.	1.	1.	1.	1.	1.	1.	1.	54.	13.
20	1.	1.	1.	1.	1.	1.	1.	1.	1.	20.

AGE/YEAR	1976	1977	1978	1979	1980	1981
2	511.	11.	1.	143.	320.	33.
3	997.	664.	40.	30.	992.	390.
4	982.	533.	2097.	176.	85.	2050.
5	229.	516.	210.	10967.	327.	135.
6	319.	287.	749.	575.	14894.	332.
7	2745.	346.	287.	1039.	412.	8443.
8	15428.	4160.	2266.	456.	1304.	224.
9	764.	16333.	8617.	2710.	258.	570.
10	2851.	926.	15951.	7042.	991.	226.
11	541.	2642.	627.	11351.	7116.	624.
12	54.	501.	1788.	446.	11471.	4473.
13	386.	50.	339.	1272.	451.	7211.
14	224.	358.	34.	241.	1285.	284.
15	522.	208.	242.	24.	244.	808.
16	510.	484.	141.	172.	24.	153.
17	410.	473.	328.	100.	174.	15.
18	240.	380.	320.	233.	101.	109.
19	120.	222.	257.	228.	235.	63.
20	127.	229.	364.	399.	634.	546.

HERRING AREA KLMN SS
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AGE/YEAR	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975
2	11889.	41242.	133840.	40712.	715736.	276112.	42700.	9959.	22057.	8168.
3	33991.	9570.	33765.	109486.	33143.	583281.	226060.	34621.	7976.	18003.
4	18891.	27497.	7828.	27399.	88650.	25851.	474906.	184853.	28258.	6425.
5	75723.	15211.	22208.	6240.	21074.	72256.	20920.	383144.	150700.	23112.
6	78732.	61502.	12400.	17745.	4803.	16750.	58666.	16464.	299707.	123197.
7	64184.	62723.	50111.	10033.	14245.	3712.	13481.	47310.	12402.	240316.
8	35573.	49054.	48239.	40515.	8058.	11486.	2915.	10258.	36421.	10037.
9	20030.	27299.	37684.	38383.	32774.	6391.	9179.	2222.	7353.	29157.
10	9514.	14987.	21286.	28810.	30543.	25921.	5144.	7084.	720.	5606.
11	7746.	7530.	11569.	17057.	23251.	24115.	20971.	4105.	5177.	555.
12	113.	5912.	5870.	9286.	13769.	18323.	19499.	16918.	3002.	3999.
13	62.	92.	4352.	4728.	7504.	10857.	14805.	15719.	13008.	2320.
14	135.	50.	74.	3435.	3829.	5935.	8775.	11925.	12048.	10325.
15	70.	110.	40.	60.	2745.	3046.	4802.	7070.	9106.	9547.
16	48.	56.	89.	32.	48.	2106.	2470.	3875.	5407.	7202.
17	55.	39.	45.	72.	25.	39.	1686.	1998.	2981.	4279.
18	22.	44.	31.	36.	58.	20.	31.	1342.	1553.	2368.
19	21.	17.	35.	24.	29.	47.	15.	24.	971..	1240.
20	23.	16.	13.	28.	19.	23.	37.	12.	19.	746.

AGE/YEAR	1976	1977	1978	1979	1980	1981
2	148886.	3759.	1610.	35290.	8119.	1058.
3	6601.	121436.	3068.	1317.	28764.	6357.
4	14072.	4502.	98822.	2476.	1051.	22652.
5	4948.	10632.	3204.	79011.	1868.	784.
6	18751.	3844.	8238.	2433.	54766.	1233.
7	99704.	15063.	2888.	6067.	1472.	31362.
8	189279.	79147.	12020.	2105.	4027.	832.
9	8003.	141009.	61036.	7791.	1310.	2117.
10	23546.	5861.	100669.	42175.	3926.	839.
11	4463.	16698.	3961.	67988.	28158.	2318.
12	442.	3165.	11280.	2675.	45393.	16615.
13	3184.	313.	2138.	7618.	1787.	26785.
14	1847.	2257.	211.	1444.	5086.	1055.
15	8331.	1309.	1524.	142.	964.	3001.
16	7697.	6349.	884.	1029.	95.	568.
17	5800.	5841.	4760.	596.	687.	56.
18	3447.	4378.	4354.	3600.	397.	405.
19	1910.	2605.	3240.	3275.	2737.	234.
20	1003.	1456.	1932.	2421.	2475.	2028.

HERRING AREA KLMN SS

F I S H I N G M O R T A L I T I E S

AGE/YEAR	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975
2	.017	.000	.001	.006	.005	.000	.010	.022	.003	.01
3	.012	.001	.009	.011	.048	.006	.001	.003	.016	.04
4	.017	.014	.027	.062	.004	.012	.015	.004	.001	.061
5	.008	.004	.024	.062	.030	.008	.040	.046	.002	.009
6	.027	.005	.012	.020	.058	.017	.015	.083	.021	.01
7	.069	.063	.013	.019	.015	.042	.073	.062	.012	.039
8	.065	.064	.029	.012	.032	.024	.072	.133	.022	.026
9	.090	.049	.068	.028	.035	.017	.059	.926	.071	.014
10	.034	.059	.021	.014	.036	.012	.026	.114	.060	.028
11	.070	.049	.020	.014	.038	.012	.015	.113	.058	.028
12	.010	.106	.016	.013	.038	.013	.015	.063	.058	.028
13	.018	.012	.037	.011	.035	.013	.016	.066	.031	.028
14	.008	.022	.015	.024	.029	.012	.016	.070	.033	.015
15	.016	.010	.028	.019	.065	.010	.015	.068	.035	.015
16	.023	.020	.012	.035	.023	.023	.012	.062	.034	.016
17	.020	.029	.025	.015	.045	.029	.028	.052	.030	.016
18	.053	.025	.037	.031	.019	.058	.037	.123	.025	.015
19	.054	.068	.032	.047	.039	.024	.075	.047	.063	.012
20	.050	.070	.090	.040	.060	.050	.030	.100	.060	.030

AGE/YEAR	1976	1977	1978	1979	1980	1981
2	.004	.003	.001	.004	.045	.035
3	.183	.006	.015	.025	.039	.070
4	.080	.140	.024	.082	.094	.105
5	.052	.055	.075	.167	.215	.210
6	.019	.086	.106	.303	.357	.350
7	.031	.026	.116	.210	.370	.350
8	.094	.060	.234	.274	.443	.350
9	.111	.137	.170	.485	.245	.350
10	.144	.192	.193	.204	.327	.350
11	.144	.192	.192	.204	.328	.350
12	.145	.192	.193	.204	.328	.350
13	.144	.194	.193	.204	.327	.350
14	.144	.193	.196	.204	.327	.350
15	.072	.193	.193	.207	.328	.350
16	.076	.088	.194	.204	.329	.350
17	.081	.094	.079	.205	.328	.350
18	.080	.101	.085	.074	.330	.350
19	.072	.099	.092	.080	.100	.350
20	.150	.190	.190	.200	.330	.350

MEAN WEIGHTS SPRING. SPAWNERS

AGE/YEAR	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975
2	76.000	76.000	76.000	76.000	76.000	76.000	76.000	88.000	76.000	72.000
3	150.000	150.000	150.000	150.000	150.000	150.000	196.000	157.000	150.000	149.000
4	196.000	196.000	196.000	196.000	196.000	196.000	203.000	194.000	196.000	196.000
5	225.000	225.000	225.000	225.000	225.000	215.000	210.000	204.000	225.000	233.000
6	257.000	257.000	257.000	257.000	257.000	250.000	275.000	250.000	240.000	237.000
7	278.000	278.000	278.000	278.000	278.000	278.000	277.000	309.000	299.000	270.000
8	296.000	296.000	296.000	296.000	296.000	296.000	279.000	324.000	313.000	300.000
9	322.000	322.000	322.000	322.000	322.000	322.000	317.000	351.000	318.000	334.000
10	333.000	333.000	333.000	333.000	333.000	334.000	346.000	370.000	333.000	339.000
11	363.000	363.000	363.000	363.000	363.000	370.000	363.000	389.000	371.000	392.000
12	363.000	363.000	363.000	363.000	363.000	370.000	363.000	389.000	371.000	392.000
13	363.000	363.000	363.000	363.000	363.000	370.000	363.000	389.000	371.000	392.000
14	363.000	363.000	363.000	363.000	363.000	370.000	363.000	389.000	371.000	392.000
15	363.000	363.000	363.000	363.000	363.000	370.000	363.000	389.000	371.000	392.000
16	363.000	363.000	363.000	363.000	363.000	370.000	363.000	389.000	371.000	392.000
17	363.000	363.000	363.000	363.000	363.000	370.000	363.000	389.000	371.000	392.000
18	363.000	363.000	363.000	363.000	363.000	370.000	363.000	389.000	371.000	392.000
19	363.000	363.000	363.000	363.000	363.000	370.000	363.000	389.000	371.000	392.000
20	363.000	363.000	363.000	363.000	363.000	370.000	363.000	389.000	371.000	392.000

AGE/YEAR	1976	1977	1978	1979	1980	1981
2	71.000	64.000	76.000	87.000	98.000	72.000
3	135.000	122.000	167.000	125.000	158.000	176.000
4	177.000	194.000	172.000	234.000	221.000	234.000
5	227.000	219.000	247.000	241.000	261.000	308.000
6	238.000	250.000	279.000	287.000	291.000	329.000
7	259.000	252.000	289.000	319.000	341.000	367.000
8	290.000	267.000	292.000	334.000	351.000	394.000
9	310.000	289.000	314.000	340.000	367.000	416.000
10	319.000	297.000	328.000	357.000	375.000	412.000
11	380.000	338.000	344.000	389.000	409.000	463.000
12	380.000	338.000	344.000	389.000	409.000	463.000
13	380.000	338.000	344.000	389.000	409.000	463.000
14	380.000	338.000	344.000	389.000	409.000	463.000
15	380.000	338.000	344.000	389.000	409.000	463.000
16	380.000	338.000	344.000	389.000	409.000	463.000
17	380.000	338.000	344.000	389.000	409.000	463.000
18	380.000	338.000	344.000	389.000	409.000	463.000
19	380.000	338.000	344.000	389.000	409.000	463.000
20	380.000	338.000	344.000	389.000	409.000	463.000

HERRING AREA KLMN SS
CATCH PROJECTION FOR 1982

AGE	POPULATION NUMBERS	POPULATION WEIGHT	FISHING MORTALITY	CATCH NUMBERS	CATCH WEIGHT	RESIDUAL NUMBERS	RESIDUAL WEIGHT
2	5000.	360.	.040	180.	13.	3931.	283.
3	836.	147.	.081	59.	10.	632.	111.
4	4853.	1136.	.122	504.	118.	3519.	823.
5	16698.	5143.	.243	3278.	1010.	10722.	3302.
6	520.	171.	.405	158.	52.	284.	93.
7	712.	261.	.405	216.	79.	389.	143.
8	18094.	7129.	.405	5498.	2166.	9881.	3893.
9	480.	200.	.405	146.	61.	262.	109.
10	1222.	513.	.405	371.	156.	667.	280.
11	484.	224.	.405	147.	68.	264.	122.
12	1337.	619.	.405	406.	188.	730.	338.
13	9586.	4438.	.405	2913.	1349.	5235.	2424.
14	15454.	7155.	.405	4696.	2174.	8439.	3907.
15	609.	282.	.405	185.	86.	332.	154.
16	1732.	802.	.405	526.	244.	946.	438.
17	328.	152.	.405	100.	46.	179.	83.
18	32.	15.	.405	10.	5.	18.	8.
19	234.	108.	.405	71.	33.	128.	59.
20	1305.	604.	.405	397.	184.	713.	330.
TOTAL	79515.	29459.		19861.	8041.	47269.	16901.

HERRING AREA KLMN SS
CATCH PROJECTION FOR 1983

AGE	POPULATION NUMBERS	POPULATION WEIGHT	FISHING MORTALITY	CATCH NUMBERS	CATCH WEIGHT	RESIDUAL NUMBERS	RESIDUAL WEIGHT
2	5000.	360.	.040	180.	13.	3931.	283.
3	3931.	692.	.081	278.	49.	2968.	522.
4	632.	148.	.122	66.	15.	458.	107.
5	3519.	1084.	.243	691.	213.	2259.	696.
6	10722.	3527.	.405	3258.	1072.	5855.	1926.
7	284.	104.	.405	86.	32.	155.	57.
8	389.	153.	.405	118.	47.	212.	84.
9	9881.	4110.	.405	3002.	1249.	5396.	2245.
10	262.	110.	.405	80.	33.	143.	60.
11	667.	309.	.405	203.	94.	364.	169.
12	264.	122.	.405	80.	37.	144.	67.
13	730.	338.	.405	222.	103.	399.	185.
14	5235.	2424.	.405	1591.	736.	2859.	1324.
15	8439.	3907.	.405	2564.	1187.	4608.	2134.
16	332.	154.	.405	101.	47.	181.	84.
17	946.	438.	.405	287.	133.	516.	239.
18	179.	83.	.405	54.	25.	98.	45.
19	18.	8.	.405	5.	2.	10.	4.
20	840.	389.	.405	255.	118.	459.	212.
TOTAL	52269.	18461.		13122.	5206.	31016.	10442.

C A T C H M A T R I X AUTUMN-SPAWNERS

AGE/YEAR	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975
2	104.	1.	1.	17.	1.	31.	29.	1.	1.	1.
3	181.	28.	226.	300.	890.	1.	102.	269.	12.	96.
4	639.	51.	131.	540.	176.	2.	113.	444.	149.	174.
5	277.	529.	201.	279.	136.	54.	78.	669.	118.	1110.
6	274.	306.	1037.	616.	243.	354.	268.	648.	58.	327.
7	277.	116.	294.	519.	486.	966.	352.	1054.	125.	78.
8	1007.	322.	223.	158.	169.	2070.	463.	1118.	58.	112.
9	1105.	927.	288.	122.	126.	1114.	960.	2383.	208.	67.
10	926.	1128.	1208.	164.	225.	723.	279.	2204.	205.	63.
11	2781.	788.	677.	403.	247.	729.	568.	407.	403.	187.
12	1.	2367.	472.	226.	606.	800.	573.	829.	74.	368.
13	1.	1.	1419.	157.	340.	1964.	629.	837.	152.	68.
14	1.	1.	1.	473.	236.	1102.	1543.	919.	153.	139.
15	1.	1.	1.	1.	711.	765.	866.	2253.	168.	140.
16	1.	1.	1.	1.	1.	2304.	601.	1265.	412.	153.
17	1.	1.	1.	1.	1.	1.	1809.	878.	231.	376.
18	1.	1.	1.	1.	1.	1.	1.	2641.	161.	211.
19	1.	1.	1.	1.	1.	1.	1.	1.	483.	147.
20	1.	1.	1.	1.	1.	1.	1.	1.	1.	440.

AGE/YEAR	1976	1977	1978	1979	1980	1981
2	1.	1.	1.	1.	16.	1.
3	59.	3.	15.	19.	215.	63.
4	47.	61.	53.	70.	83.	443.
5	102.	113.	452.	288.	143.	202.
6	338.	302.	311.	2542.	253.	93.
7	470.	746.	1130.	626.	1542.	216.
8	108.	388.	1841.	1396.	224.	833.
9	158.	214.	589.	2038.	691.	159.
10	52.	99.	379.	552.	282.	101.
11	110.	94.	77.	427.	377.	144.
12	324.	197.	73.	87.	291.	192.
13	637.	581.	153.	82.	59.	148.
14	118.	1143.	451.	172.	56.	30.
15	241.	212.	888.	508.	117.	29.
16	242.	432.	165.	1000.	346.	60.
17	265.	434.	336.	186.	682.	176.
18	651.	475.	337.	378.	127.	347.
19	365.	1168.	369.	329.	257.	65.
20	1016.	2477.	2832.	3605.	2715.	1514.

MEAN WEIGHTS AUTUMN - SPAWNERS

AGE/YEAR	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975
2	50.000	50.000	50.000	50.000	50.000	50.000	50.000	50.000	50.000	50.000
3	120.000	120.000	120.000	120.000	120.000	120.000	120.000	161.000	120.000	114.000
4	174.000	174.000	174.000	174.000	174.000	174.000	174.000	181.000	215.000	164.000
5	226.000	226.000	226.000	226.000	226.000	226.000	226.000	254.000	225.000	221.000
6	253.000	253.000	253.000	253.000	253.000	272.000	238.000	293.000	235.000	248.000
7	284.000	284.000	284.000	284.000	284.000	308.000	239.000	306.000	284.000	273.000
8	307.000	307.000	307.000	307.000	307.000	328.000	275.000	315.000	307.000	278.000
9	319.000	319.000	319.000	319.000	319.000	362.000	280.000	324.000	319.000	305.000
10	337.000	337.000	337.000	337.000	337.000	378.000	287.000	349.000	376.000	372.000
11	405.000	405.000	405.000	405.000	405.000	448.000	376.000	362.000	415.000	432.000
12	405.000	405.000	405.000	405.000	405.000	448.000	376.000	362.000	415.000	432.000
13	405.000	405.000	405.000	405.000	405.000	448.000	376.000	362.000	415.000	432.000
14	405.000	405.000	405.000	405.000	405.000	448.000	376.000	362.000	415.000	432.000
15	405.000	405.000	405.000	405.000	405.000	448.000	376.000	362.000	415.000	432.000
16	405.000	405.000	405.000	405.000	405.000	448.000	376.000	362.000	415.000	432.000
17	405.000	405.000	405.000	405.000	405.000	448.000	376.000	362.000	415.000	432.000
18	405.000	405.000	405.000	405.000	405.000	448.000	376.000	362.000	415.000	432.000
19	405.000	405.000	405.000	405.000	405.000	448.000	376.000	362.000	415.000	432.000
20	405.000	405.000	405.000	405.000	405.000	448.000	376.000	362.000	415.000	432.000

AGE/YEAR	1976	1977	1978	1979	1980	1981
2	50.000	50.000	50.000	50.000	50.000	50.000
3	91.000	120.000	120.000	114.000	122.000	126.000
4	156.000	163.000	174.000	165.000	224.000	212.000
5	190.000	224.000	228.000	239.000	229.000	257.000
6	240.000	231.000	252.000	270.000	287.000	288.000
7	255.000	258.000	315.000	321.000	321.000	368.000
8	307.000	277.000	319.000	348.000	357.000	400.000
9	319.000	319.000	323.000	361.000	380.000	436.000
10	337.000	337.000	337.000	370.000	381.000	486.000
11	393.000	382.000	418.000	415.000	497.000	524.000
12	393.000	382.000	418.000	415.000	497.000	524.000
13	393.000	382.000	418.000	415.000	497.000	524.000
14	393.000	382.000	418.000	415.000	497.000	524.000
15	393.000	382.000	418.000	415.000	497.000	524.000
16	393.000	382.000	418.000	415.000	497.000	524.000
17	393.000	382.000	418.000	415.000	497.000	524.000
18	393.000	382.000	418.000	415.000	497.000	524.000
19	393.000	382.000	418.000	415.000	497.000	524.000
20	393.000	382.000	418.000	415.000	497.000	524.000

HERRING AREA KLMN AS
F I S H I N G M O R T A L I T I E S

AGE/YEAR	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975
2	.005	.000	.000	.004	.000	.003	.002	.000	.000	.000
3	.005	.001	.029	.073	.258	.000	.011	.021	.002	.024
4	.056	.001	.007	.080	.050	.001	.018	.057	.013	.026
5	.005	.054	.006	.017	.024	.018	.032	.126	.017	.114
6	.004	.006	.128	.022	.017	.071	.102	.355	.013	.055
7	.004	.002	.006	.079	.019	.078	.084	.630	.095	.020
8	.012	.005	.004	.004	.030	.097	.044	.369	.055	.104
9	.018	.012	.005	.003	.003	.251	.053	.295	.096	.075
10	.019	.021	.018	.003	.005	.021	.082	.150	.033	.034
11	.057	.018	.014	.007	.005	.019	.018	.148	.033	.035
12	.015	.057	.012	.005	.011	.018	.017	.030	.033	.035
13	.042	.017	.040	.005	.009	.041	.016	.027	.006	.034
14	.029	.049	.019	.015	.008	.032	.037	.027	.006	.006
15	.033	.033	.057	.021	.025	.028	.028	.062	.005	.006
16	.029	.038	.038	.067	.024	.097	.025	.048	.013	.006
17	.033	.033	.044	.044	.080	.027	.093	.042	.010	.013
18	.051	.038	.038	.051	.051	.097	.031	.170	.009	.010
19	.075	.059	.043	.043	.059	.059	.119	.035	.038	.009
20	.090	.090	.070	.050	.050	.070	.070	.150	.040	.040

AGE/YEAR	1976	1977	1978	1979	1980	1981
2	.000	.000	.000	.000	.002	.002
3	.004	.001	.008	.002	.007	.008
4	.013	.004	.019	.040	.011	.015
5	.017	.036	.035	.125	.096	.030
6	.042	.059	.117	.249	.138	.075
7	.095	.110	.290	.323	.210	.150
8	.031	.095	.379	.614	.164	.150
9	.188	.071	.183	.831	.623	.150
10	.069	.155	.155	.234	.221	.150
11	.070	.154	.155	.234	.221	.150
12	.070	.155	.154	.235	.222	.150
13	.070	.155	.155	.231	.222	.150
14	.069	.155	.155	.233	.218	.150
15	.012	.154	.155	.234	.220	.150
16	.011	.025	.154	.234	.222	.150
17	.011	.022	.022	.233	.222	.150
18	.026	.022	.019	.028	.220	.150
19	.020	.054	.019	.025	.021	.150
20	.070	.160	.160	.230	.220	.150

HERRING AREA KLMN AS

POPULATION NUMBERS

AGE/YEAR	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975
2	23369.	9260.	4982.	4563.	8155.	10405.	15102.	8646.	4748.	18885.
3	41143.	21046.	8378.	4507.	4113.	7378.	9385.	13637.	7822.	4295.
4	12332.	37056.	19017.	7366.	3793.	2875.	6675.	8395.	12084.	7066.
5	63162.	10550.	33481.	17082.	6151.	3264.	2599.	5932.	7174.	10792.
6	69267.	56888.	9043.	30103.	15191.	5436.	2902.	2278.	4731.	6379.
7	78049.	62415.	51183.	7196.	26653.	13515.	4582.	2371.	1445.	4226.
8	90560.	70358.	56365.	46033.	6018.	23654.	11310.	3811.	1143.	1186.
9	65387.	80984.	63356.	50789.	41502.	5284.	19434.	9793.	2385.	979.
10	51083.	58114.	72396.	57053.	45840.	37432.	3722.	16671.	6594.	1960.
11	52455.	45341.	51511.	64357.	51468.	41263.	33183.	3102.	12988.	5772.
12	72.	44818.	40277.	45965.	57850.	46335.	36643.	29484.	2420.	11369.
13	25.	64.	38302.	35995.	41376.	51768.	41165.	32611.	25890.	2119.
14	37.	22.	57.	33307.	32420.	37115.	44973.	36649.	28712.	23282.
15	32.	32.	19.	51.	29687.	29111.	32535.	39226.	32287.	25834.
16	37.	28.	28.	16.	45.	26186.	25613.	28615.	33350.	29055.
17	33.	33.	24.	24.	14.	40.	21502.	22604.	24688.	29784.
18	21.	29.	29.	21.	21.	11.	35.	17735.	19617.	22119.
19	15.	18.	25.	25.	18.	18.	9.	31.	13535.	17597.
20	12.	12.	16.	22.	22.	16.	16.	8.	27.	11788.

AGE/YEAR	1976	1977	1978	1979	1980	1981
2	3561.	2328.	9822.	38437.	9808.	701.
3	17087.	3221.	2105.	8887.	34778.	8860.
4	3795.	15405.	2912.	1891.	8023.	31264.
5	6228.	3389.	13881.	2585.	1644.	7180.
6	8709.	5539.	2959.	12130.	2065.	1352.
7	5461.	7559.	4724.	2382.	8558.	1627.
8	3750.	4494.	6130.	3200.	1559.	6276.
9	969.	3290.	3697.	3795.	1567.	1198.
10	822.	726.	2773.	2785.	1496.	761.
11	1714.	694.	563.	2149.	1995.	1085.
12	5045.	1446.	539.	436.	1538.	1447.
13	9937.	4256.	1121.	418.	312.	1115.
14	1853.	8386.	3299.	869.	300.	226.
15	20934.	1564.	6500.	2556.	623.	219.
16	23242.	18713.	1214.	5037.	1829.	452.
17	26144.	20800.	16521.	941.	3606.	1326.
18	26592.	23404.	18408.	14629.	675.	2615.
19	19814.	23442.	20725.	16336.	12877.	490.
20	15783.	17581.	20101.	18402.	14421.	11408.

HERRING AREA KLMN AS
CATCH PROJECTION FOR 1982

AGE	POPULATION NUMBERS	POPULATION WEIGHT	FISHING MORTALITY	CATCH NUMBERS	CATCH WEIGHT	RESIDUAL NUMBERS	RESIDUAL WEIGHT
2	5000.	250.	.004	18.	1.	4507.	225.
3	633.	80.	.019	11.	1.	563.	71.
4	7957.	1687.	.037	277.	59.	6936.	1470.
5	27868.	7162.	.075	1908.	490.	23403.	6015.
6	6305.	1816.	.186	1022.	294.	4734.	1364.
7	1135.	418.	.373	337.	124.	707.	260.
8	1267.	507.	.373	377.	151.	790.	316.
9	4888.	2131.	.373	1453.	633.	3046.	1328.
10	933.	453.	.373	277.	135.	581.	283.
11	593.	311.	.373	176.	92.	369.	194.
12	845.	443.	.373	251.	132.	527.	276.
13	1127.	590.	.373	335.	175.	702.	368.
14	868.	455.	.373	258.	135.	541.	284.
15	176.	92.	.373	52.	27.	110.	57.
16	170.	89.	.373	51.	27.	106.	56.
17	352.	184.	.373	105.	55.	219.	115.
18	1033.	541.	.373	307.	161.	644.	337.
19	2036.	1067.	.373	605.	317.	1269.	665.
20	9266.	4855.	.373	2754.	1443.	5774.	3025.
TOTAL	72452.	23132.		10574.	4453.	55528.	16708.

HERRING AREA KLMN AS
CATCH PROJECTION FOR 1983

AGE	POPULATION NUMBERS	POPULATION WEIGHT	FISHING MORTALITY	CATCH NUMBERS	CATCH WEIGHT	RESIDUAL NUMBERS	RESIDUAL WEIGHT
2	5000.	250.	.004	18.	1.	4507.	225.
3	4507.	568.	.019	79.	10.	4003.	504.
4	563.	119.	.037	20.	4.	490.	104.
5	6936.	1783.	.075	475.	122.	5825.	1497.
6	23403.	6740.	.186	3795.	1093.	17573.	5061.
7	4734.	1742.	.373	1407.	518.	2950.	1086.
8	707.	283.	.373	210.	84.	441.	176.
9	790.	344.	.373	235.	102.	492.	215.
10	3046.	1480.	.373	905.	440.	1898.	922.
11	581.	305.	.373	173.	91.	362.	190.
12	369.	194.	.373	110.	58.	230.	121.
13	527.	276.	.373	156.	82.	328.	172.
14	702.	368.	.373	209.	109.	437.	229.
15	541.	284.	.373	161.	84.	337.	177.
16	110.	57.	.373	33.	17.	68.	36.
17	106.	56.	.373	32.	17.	66.	35.
18	219.	115.	.373	65.	34.	137.	72.
19	644.	337.	.373	191.	100.	401.	210.
20	7042.	3690.	.373	2093.	1097.	4388.	2300.
TOTAL	60528.	18991.		10366.	4063.	44935.	13331.

Newfoundland West Coast Herring Stock - Moores & Winters

Autumn-spawners $F_T = 0.35$ $M = 0.10$

(1) F matrix

(2) Population matrix

(3) Biomass, Population Numbers, and F_{5-18}

(4) Catch projections (i) 1982
(ii) 1983

HERRING AREA KLMN AS
F I S H I N G M O R T A L I T I E S

AGE/YEAR	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975
2	.005	.000	.000	.004	.000	.004	.002	.000	.000	.000
3	.005	.002	.032	.080	.287	.000	.014	.023	.002	.033
4	.062	.002	.008	.090	.055	.001	.023	.072	.014	.029
5	.008	.060	.007	.020	.027	.019	.036	.165	.022	.128
6	.007	.010	.145	.026	.020	.081	.114	.413	.017	.071
7	.005	.003	.011	.090	.023	.092	.097	.743	.116	.026
8	.015	.007	.007	.006	.034	.116	.052	.444	.069	.129
9	.022	.015	.007	.004	.006	.295	.065	.363	.122	.096
10	.024	.025	.023	.004	.008	.037	.100	.187	.042	.044
11	.065	.023	.017	.008	.007	.030	.033	.186	.042	.045
12	.018	.065	.015	.006	.014	.027	.027	.056	.042	.045
13	.028	.020	.045	.006	.011	.052	.024	.044	.012	.044
14	.032	.032	.022	.017	.009	.039	.048	.040	.009	.012
15	.037	.037	.037	.025	.029	.035	.035	.082	.008	.009
16	.029	.042	.042	.042	.029	.113	.031	.060	.018	.008
17	.033	.033	.049	.049	.049	.033	.109	.053	.013	.018
18	.051	.038	.038	.057	.057	.057	.038	.206	.011	.013
19	.083	.059	.043	.043	.067	.067	.067	.043	.047	.011
20	.100	.100	.070	.050	.050	.080	.080	.080	.050	.050

AGE/YEAR	1976	1977	1978	1979	1980	1981
2	.000	.001	.000	.000	.004	.004
3	.005	.002	.014	.005	.015	.018
4	.018	.006	.032	.078	.025	.039
5	.019	.050	.052	.220	.202	.070
6	.047	.066	.169	.402	.273	.173
7	.125	.124	.334	.527	.403	.350
8	.042	.130	.449	.781	.320	.350
9	.242	.098	.265	.179	.042	.350
10	.091	.211	.225	.376	.422	.350
11	.092	.210	.225	.377	.423	.350
12	.092	.211	.224	.379	.423	.350
13	.092	.211	.225	.373	.423	.350
14	.091	.211	.225	.376	.417	.350
15	.023	.210	.225	.377	.421	.350
16	.018	.048	.224	.377	.423	.350
17	.016	.037	.043	.375	.423	.350
18	.035	.033	.033	.056	.421	.350
19	.025	.074	.029	.043	.045	.350
20	.090	.210	.230	.380	.420	.350

HERRING AREA KLMN AS

POPULATION NUMBERS

AGE/YEAR	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975
2	20224.	8290.	4558.	4166.	6383.	8324.	13690.	7750.	3471.	12834.
3	34943.	18201.	7500.	4123.	3754.	5774.	7503.	12360.	7011.	3140.
4	11170.	31446.	16442.	6572.	3445.	2550.	5224.	6692.	10928.	6333.
5	36111.	9500.	28405.	14753.	5433.	2950.	2305.	4619.	5633.	9746.
6	44406.	32411.	8092.	25510.	13084.	4786.	2618.	2012.	3543.	4984.
7	54356.	39920.	29036.	6336.	22497.	11607.	3994.	2114.	1204.	3151.
8	71820.	48920.	36011.	25993.	5239.	19894.	9584.	3279.	910.	970.
9	53782.	64028.	43959.	32372.	23369.	4580.	16032.	8231.	1904.	768.
10	41875.	47613.	57053.	39501.	29175.	21026.	3084.	13593.	5181.	1525.
11	46770.	37009.	42009.	50474.	35586.	26185.	18337.	2525.	10203.	4493.
12	60.	39674.	32737.	37367.	45288.	31965.	22999.	16052.	1898.	8848.
13	38.	54.	33647.	29173.	33596.	40402.	28162.	20266.	13736.	1647.
14	33.	33.	47.	29095.	26247.	30076.	34689.	24884.	17541.	12284.
15	29.	29.	29.	42.	25876.	23525.	26165.	29920.	21642.	15726.
16	37.	25.	25.	25.	37.	22738.	20559.	22852.	24930.	19422.
17	33.	33.	22.	22.	22.	33.	18382.	18031.	19474.	22165.
18	21.	29.	29.	19.	19.	19.	29.	14912.	15480.	17401.
19	13.	18.	25.	25.	16.	16.	16.	25.	10981.	13853.
20	11.	11.	16.	22.	22.	14.	14.	14.	22.	9476.

AGE/YEAR	1976	1977	1978	1979	1980	1981
2	2142.	1218.	4365.	16777.	4234.	301.
3	11612.	1937.	1101.	3949.	15180.	3816.
4	2750.	10451.	1750.	982.	3555.	13531.
5	5565.	2443.	9398.	1533.	822.	3138.
6	7763.	4938.	2103.	8074.	1113.	608.
7	4199.	6702.	4181.	1607.	4887.	766.
8	2777.	3352.	5355.	2708.	859.	2956.
9	771.	2410.	2664.	3094.	1122.	564.
10	631.	548.	1977.	1850.	861.	358.
11	1320.	522.	401.	1428.	1149.	511.
12	3888.	1089.	383.	290.	886.	681.
13	7656.	3210.	798.	277.	180.	525.
14	1426.	6322.	2352.	577.	173.	106.
15	10983.	1178.	4633.	1699.	358.	103.
16	14096.	9708.	864.	3347.	1054.	213.
17	17429.	12525.	8374.	625.	2078.	624.
18	19698.	15518.	10920.	7257.	388.	1231.
19	15544.	17204.	13589.	9560.	6207.	231.
20	12395.	13718.	14456.	11945.	8290.	5372.

POPULATION BIOMASS AGES 2 TO 20

YEAR	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975
BIOMASS	114351.	112393.	108984.	104290.	98709.	101614.	76278.	68553.	65041.	61497.
YEAR	1976	1977	1978	1979	1980	1981				
BIOMASS	47938.	38236.	31610.	22615.	16317.	11259.				

POPULATION BIOMASS AGES 5 TO 20

YEAR	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975
BIOMASS	107203.	104323.	104995.	102443.	97340.	100061.	73785.	64965.	61677.	59458.
YEAR	1976	1977	1978	1979	1980	1981				
BIOMASS	46345.	36239.	30955.	21164.	13457.	7895.				

FISHING MORTALITY-WINTERS METHOD AGES 5 TO 18

YEAR	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975
TOTAL F	.020	.022	.020	.011	.014	.058	.047	.110	.019	.029
YEAR	1976	1977	1978	1979	1980	1981				
TOTAL F	.042	.084	.149	.378	.419	.263				

TOTAL POPULATION NUMBERS AGES 2 TO 20

YEAR	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975
TOTAL N	415734.	377242.	339641.	305591.	279088.	256462.	233385.	210129.	175689.	168768.
YEAR	1976	1977	1978	1979	1980	1981				
TOTAL N	142644.	114993.	89665.	77581.	53397.	35635.				

TOTAL POPULATION NUMBERS AGES 5 TO 20

YEAR	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975
TOTAL N	349396.	319306.	311141.	290730.	265507.	239814.	206969.	183328.	154279.	146461.
YEAR	1976	1977	1978	1979	1980	1981				
TOTAL N	126141.	101387.	82449.	55872.	30428.	17980.				

HERRING AREA KLMN AS
CATCH PROJECTION FOR 1982

AGE	POPULATION NUMBERS	POPULATION WEIGHT	FISHING MORTALITY	CATCH NUMBERS	CATCH WEIGHT	RESIDUAL NUMBERS	RESIDUAL WEIGHT
2	5000.	250.	.004	18.	1.	4507.	225.
3	271.	34.	.019	5.	1.	241.	30.
4	3393.	719.	.037	118.	25.	2957.	627.
5	11822.	3038.	.075	809.	208.	9928.	2552.
6	2647.	762.	.186	429.	124.	1988.	573.
7	462.	170.	.373	137.	50.	288.	106.
8	489.	195.	.373	145.	58.	305.	122.
9	1885.	822.	.373	560.	244.	1174.	512.
10	360.	175.	.373	107.	52.	224.	109.
11	228.	120.	.373	68.	36.	142.	75.
12	326.	171.	.373	97.	51.	203.	106.
13	434.	228.	.373	129.	68.	271.	142.
14	335.	175.	.373	100.	52.	209.	109.
15	68.	36.	.373	20.	11.	42.	22.
16	66.	34.	.373	19.	10.	41.	21.
17	136.	71.	.373	40.	21.	85.	44.
18	398.	209.	.373	118.	62.	248.	130.
19	785.	411.	.373	233.	122.	489.	256.
20	3572.	1872.	.373	1062.	556.	2226.	1166.
TOTAL	32676.	9492.		4215.	1751.	25568.	6928.

HERRING AREA KLMN AS
CATCH PROJECTION FOR 1983

AGE	POPULATION NUMBERS	POPULATION WEIGHT	FISHING MORTALITY	CATCH NUMBERS	CATCH WEIGHT	RESIDUAL NUMBERS	RESIDUAL WEIGHT
2	5000.	250.	.004	18.	1.	4507.	225.
3	4507.	568.	.019	79.	10.	4003.	504.
4	241.	51.	.037	8.	2.	210.	45.
5	2957.	760.	.075	202.	52.	2484.	638.
6	9928.	2859.	.186	1610.	464.	7455.	2147.
7	1988.	732.	.373	591.	217.	1239.	456.
8	288.	115.	.373	86.	34.	179.	72.
9	305.	133.	.373	90.	39.	190.	83.
10	1174.	571.	.373	349.	170.	732.	356.
11	224.	117.	.373	67.	35.	140.	73.
12	142.	75.	.373	42.	22.	89.	46.
13	203.	106.	.373	60.	32.	126.	66.
14	271.	142.	.373	80.	42.	169.	88.
15	209.	109.	.373	62.	32.	130.	68.
16	42.	22.	.373	13.	7.	26.	14.
17	41.	21.	.373	12.	6.	25.	13.
18	85.	44.	.373	25.	13.	53.	28.
19	248.	130.	.373	74.	39.	155.	81.
20	2715.	1423.	.373	807.	423.	1692.	887.
TOTAL	30568.	8229.		4276.	1640.	23603.	5890.