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An Examination of the Status of the Newfoundland
West Coast Herring Stock

by

J.A. Moores, G.H. Winters, and C.I. Barbour
Research and Resource Services
Department of Fisheries and Oceans
P.O. Box 5667
St. John's, Newfoundland
A1C 5X1

ABSTRACT

During the past five years catches from the Newfoundland west coast herring stock have risen steadily reaching almost 19,000 MT in 1980. While the purse seine catch has remained stable for the past few years the gillnet component continued to show some expansion. The catches from both spawning components were dominated by age-groups 11+ indicating that recent recruitment has not been exceedingly strong. The only exception being the 1974 year-class of spring-spawners which is estimated at 1/4 the strength of the 1968 year-class.

Two measures of catch per unit effort were available. The purse seine effort series showed an increase in CPUE which was inconsistent with the sampling data and indicated a change in efficiency due to changes in fleet activity. The gillnet data, based on a large sample size, for the period 1977-80 showed a steady decline in CPUE. Mortality rates were estimated using the linear formula of Paloheimo based on the gillnet effort data for the October-November period and indicated a 1980 F of 0.28.

The results of cohort analysis based on this level of mortality indicates a marked decline in the abundance of this stock from 228×10^3 MT in 1970 to 46×10^3 MT in 1981 (5+ biomass). A projection was performed using $F_{0.1}$ values (based on historical input values) of 0.345 for spring-spawners and 0.381 for autumn-spawners and produced a yield in 1981 of 13,400 MT. If 1980 average weights were used the 1981 yield would be 15,100 MT.

In spite of the decline in adult stock, numerous reports of young herring (year-class 1977 and younger) were received from the west coast. While the abundance of these year-classes has not yet been determined, their presence is encouraging for the future of this stock.

RESUME

Ces cinq dernières années, les prises à même le stock de harengs de la côte ouest de Terre-Neuve ont augmenté régulièrement, atteignant presque 19 000 tm en 1980. Les prises des sennes coulissantes sont demeurées stables ces quelques dernières années, mais les prises des filets maillants continueront d'augmenter. Chez les deux composants reproducteurs, les classes d'âge 11+ dominaient les prises, signe que le recrutement récent n'a pas été très abondant. La classe d'âge de 1974 des reproducteurs de printemps, estimée à $\frac{1}{4}$ de l'effectif de celle de 1968, est la seule exception.

On peut calculer les prises par unité d'effort à partir de deux sources. La série de données sur l'effort des senneurs montre une augmentation des PUE, ce qui contredit les données de l'échantillonnage et indique une efficacité différente résultant de changements dans le déploiement de la flottille. L'abondant échantillonnage des prises des filets maillants pendant la période 1977-80 indique une diminution régulière des PUE. La formule linéaire de Paloheimo fondée sur l'effort des filets maillants en octobre-novembre a été utilisée pour estimer les taux de mortalité. On obtient pour 1980 un F de 0,28.

L'analyse des cohortes à ce niveau de mortalité indique un déclin marqué de l'abondance de ce stock, de 228×10^3 tm en 1970 à 46×10^3 tm en 1981 (biomasse de 5+). Nous avons fait une projection avec des valeurs de $F_{0,1}$ (fondées sur les entrées historiques) de 0,345 pour les reproducteurs de printemps. On obtient un rendement de 13 400 tm en 1981. Si l'on utilisait les poids moyens de 1980, le rendement de 1981 serait de 15 000 tm.

En dépit du déclin du stock adulte, on a signalé à plusieurs reprises sur la côte ouest la présence de jeunes harengs (classe d'âge de 1977 et plus jeunes). Bien que les effectifs de ces classes d'âge n'aient pas encore été déterminés, leur présence est encourageante pour l'avenir de ce stock.

INTRODUCTION

Catches from the Newfoundland West Coast herring stock have been increasing since 1976 reaching 19,000 t in 1980 (Table 1). This represents a 4% increase over 1979 and a 1,000 t overrun in the 1980 quota of 18,000 mt. The overrun occurred in the gillnet component which took 9,400 t (Table 2) on a quota of 8,000 t while the purse seine fleet took 9,600 t of its 10,000 t quota. The increase in gillnet catches occurred primarily in the area of Port-au-Port (L) where the landings increased 43% over 1979.

The spring purse seine fishery occurred in the historical fashion and the bulk of the landings from the fall fishery were from the area south of Pt. Riche (Fig. 1) as occurred in 1979. The purse seine fleet also found schools of herring in the area of Shag Island (Area L). This led to the opening of the entire west coast area in December for the remaining purse seine quota. These schools were, however, composed primarily of small fish which were unacceptable to the processors and were subsequently avoided by the seiners.

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 then combined to give total removals-at-age by year from the stock (Table 3).
- (b) Age frequency in the catch: The catch from the spring-spawning component during 1980 was dominated by two age-groups; age-group 6 (1974 year-class) and age-group 11+ (predominantly 1968 and 1969 year-classes). The 1977 year-class made a slight contribution (Fig. 2).

Similarly, two age-groups represented the main contribution from the autumn-spawning component; age-group 7 (1973 year-class and age-group 11+). The 1977 year-class was a significant contribution to the fishery in the area from Cape Anguille to Cape Gregory (Fig. 2).

In both components, in all areas, the 11+ age-groups were dominant indicating that recent recruitment has not been exceedingly strong.

- (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 1 and 2).
- (d) Partial recruitment rates: The partial recruitment rates present in the 1980 fishery were examined using a comparison of the percent-at-age in the total catch to that in (1) spring research gillnet survey; (2) the spring and fall purse seine fishery and also by looking at the partial F values generated from trial runs of cohort analysis for the period 1976-78.

- (1) Research gillnet data: A series of research gillnet sets were conducted along the west coast of Newfoundland in Areas K and L during the spring of 1980 utilizing fleets of 5 gillnets each with mesh sizes from 2" to 3" in each fleet. This range of mesh sizes should capture any available fish ages 2 and greater. The catch from these sets were therefore assumed to be representative of the total population. A comparison of the percent-at-age in the total catch to that in the research sets gave reasonable results for spring-spawners (Table 4) but due to the small numbers of autumn-spawners captured in the research sets the data could not meaningfully be applied to this component.
- (2) Purse seine data: As has been done in previous years (Moore and Winters 1980), a comparison of percent-at-age in the total catch and percent-at-age in the purse seine catch was performed with the assumption that the purse seine catch would be representative of the population. This was performed separately for the spring and fall purse seine catches and in both cases gave anomalous results for both spawning types particularly for the younger age-groups. There was, however, a general indication that full recruitment in both spawning components had occurred by age 7.
- (3) Historical F values: Due to the many changes which have occurred in this fishery a recent series of years were selected from the F matrix (1976-78) for calculation of partial recruitment rates. These average values are given in Table 4.

For the autumn-spawning component the partial F values were the only reliable source of data and were used to generate PR values. The research gillnet data were felt to be most indicative of the PR rates for spring-spawners however the historical F values were utilized to evaluate these results. The resultant values generated by these analyses are shown in Table 4.

The PR values for 1980 show a reduction, from those used in the previous assessment, of the age of full recruitment to age 6 for spring-spawners and age 7 for autumn-spawners.

- (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 5) indicate that CPUE has increased in both the spring and fall fisheries. The catch rates in the spring fishery were the highest observed in this fishery while those observed in the fall fishery are comparable to peak values in the time series. These apparent increases however do not appear warranted in light of the age composition of the catch which was still dominated by age-groups 11+ in 1980. The catch rates may therefore reflect the

recurring problems of utilizing purse seine effort series in assessing pelagic stocks and the additional compounding factor of group fishing due to the imposition of nightly quotas in 1980.

An alternate source of catch rate data exists from gillnets in the form of sales slip records. These data have been successfully utilized in several stock areas particularly the east coast of Newfoundland (Wheeler and Winters 1980). Data were available from the west coast of Newfoundland for the period 1977-80 for all statistical areas however Area N was selected for the analysis as the fishery in this area has the longest historical background.

It was felt that this area would provide the most consistent data and it has the additional advantage of occurring throughout the entire summer and fall period. The results (Table 6) show a general decline in catch per landing for all months except September. These results are consistent with the age structure found in the catch.

- (f) Natural mortality rate: As in the previous assessment (Moore and Winters 1980) the natural mortality rate was set at 0.20 for both spawning components.

Calculation of Terminal F:

Traditionally for this stock the purse seine CPUE and effort series have been used to fine tune the estimate of fishing mortality in the terminal year. The 1980 purse seine data indicate that there has been a substantial increase in CPUE which would suggest an increase in stock size in 1980. This, however, is inconsistent with both the increase in catches and expanding nature of the fishery and the age composition of the catch which does not indicate any substantial recruitment to the fishery. The gillnet data encompass a large sample volume and was felt to be more reliable and therefore was used to derive estimates of Z .

The sales slip records were used to calculate an average monthly catch per landing in each year with each slip assumed to represent one landing (Table 6). No data, however, were available to estimate changes in average fleet size used per fisherman in this area. With improved market conditions and price for herring it would, however, be expected that changes such as have been observed along the east coast of Newfoundland (Wheeler and Winters 1980) had also occurred in the west coast. The average catch rates from the west coast were therefore adjusted by the correction factors (Table 7) derived for the east coast of Newfoundland (J.P. Wheeler, pers. comm.) to incorporate changes in the effective effort of the gillnet fishery. Using these values Paloheimo Z 's were calculated for each month utilizing catch and effort data from the Area N gillnet fishery only. These calculations were performed separately for each spawning component then combined on the basis of percent of each spawning component contributing to the fishery in that month. As there appeared to be a consistent pattern

regard to the relative contribution of each component to the catch by month, an average monthly value of the percent spawning type was used in cases where no sampling data were available. The results are given in Table 7.

The proportion of the two spawning components present in the total population is most closely approximated by the months of October and November which gave an unweighted average Z between 1979-80 of 0.48. As this time period essentially represents the 1980 fishing season the $Z = 0.48$ is a measure of the mortality generated in 1980.

Using the parameters described above cohort analyses were performed separately for each spawning component with the runs which produced an $F_{5-18} = 0.28$ in 1980 being accepted as the best estimate of the population. These runs were generated at an $F_T = 0.28$ for spring-spawners and 0.33 for autumn-spawners. F values for the terminal age in all years, other than 1980, were derived by inspection from trial runs of cohort analysis. A plot of the adjusted October-November catch rates against the exploitable biomass in the stock (Fig. 3) shows a good relationship ($r = 0.98$) indicating that the gillnet data were a good indicator of total stock abundance.

Results of Assessment:

Trends in Biomass and F: The 5+ biomass of autumn-spawners has shown a continuous decline from 230.4×10^3 t in 1970 to 8.1×10^3 t at the start of 1981 (Table 8). Among spring-spawners 5+ biomass peaked in 1974 at 165.3×10^3 t and has subsequently declined to 38.1×10^3 t. The recruitment of the 1974 year-class to the 5+ biomass in 1979 was sufficient to maintain the biomass but not increase it. Total 5+ biomass has declined from 287.5×10^3 t in 1970 to 46.2×10^3 t in 1981.

For both autumn- and spring-spawners the fishing mortality remained at a low level up to 1975 (Table 8). Since 1976 fishing mortality has increased sharply due to the major expansion in the fishery. While spring-spawners show a continuous increase from 1976 to 1980, autumn-spawners show a slight decline in mortality in 1980.

Trends in Recruitment: Recruitment to the autumn-spawning component has generally been poor and has led to the precipitous decline in this component from 624×10^6 individuals (2+) in 1970 to 47×10^6 individuals in 1981 (Table 9). Similarly in the spring-spawning component recruitment has been poor with the exception of the 1974 year-class which is estimated at 1/4 the strength of the 1968 year-class. In the previous assessment (Moore and Winters 1980) the 1974 year-class had been estimated at 1/2 the strength of the 1968 year-class. The number of individuals (2+) in this component peaked in 1971 at $1,167 \times 10^6$ individuals and has declined since then to 143×10^6 individuals at the start of 1981.

At variance with the indication of poor recruitment are continuing reports of large quantities of small fish. During the research gillnet sets in St. George's Bay in 1980 the dominant year-class caught was the 1977 year-class of spring-spawners. The purse seine fleet also report large schools of small herring off Shag Island in December 1980. Samples of these sets indicated a predominance of the 1977 year-class for both spawning types as well as some 1978 year-class fish. In November large quantities of 1980 year-class herring were reported in Hawke's Bay and subsequent reports indicated heavy predation by codfish on these herring.

A survey conducted in January 1981 aboard the MV Martin & Phillip indicated herring present over a wide area of the northern Gulf of St. Lawrence (Fig. 4). The sets were composed mainly of juvenile herring.

In February a redfish survey reported quantities of juvenile herring taken as a by-catch in the area of Anticosti Island. While it is impossible to accurately interpret the meaning of these reports, as no time series of juvenile surveys presently exists, they may indicate a general improvement in herring recruitment in the northern Gulf of St. Lawrence.

Catch Projection:

- (a) Partial recruitment rates: The partial recruitment rates used in the projection were the same as used for cohort analysis (Table 10). In the case of autumn-spawners these represent the historical average (1976-78) while for spring-spawners the values, while not representing the historical average, appear to be reasonable under the current exploitation pattern.
- (b) Average weights-at-age: The weights-at-age used in the projection were average values observed in the first and second quarter from 1976-80 (Table 10) and are lower than those observed in the 1980 fishery.
- (c) Calculation of $F_{0.1}$: Using these parameters with the weights-at-age extended to age 15 $F_{0.1}$ values were calculated separately for spring- and autumn-spawners. $F_{0.1}$ level for spring-spawners was 0.345 and 0.381 for autumn-spawners. It is expected that these values should not vary to any great extent in the near future as they were derived from a more general data set than has been the practice in past assessments.
- (d) 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 5×10^6 individuals. A comparison of calculated catch in 1980 to the actual catch gave a correction factor of 1.051. The results are:

	<u>Autumn-spawners</u>	<u>Spring-spawners</u>	<u>Total</u>
Projected catch (t)	2,270	10,474	12,744
Adj. catch (t)	2,386	11,008	13,394
5+ biomass 82 x 10 ⁻³ t	7.3	25.2	32.5

(detailed catch projection given in Appendices)

It should be noted that if the weight-at-age data from the most recent years fishery (1980) had been used in the projection, the 1981 catch level would have been 15,112 t (AS = 2,760 t, SS = 12,352).

DISCUSSION

The above analysis shows a continued decline in the abundance of the Newfoundland west coast herring stock. This decline has been the result of poor recruitment, however, recent reports indicate that this situation may be moderating but to what extent is unknown. It does appear that although these year-classes (1977 and younger) may show up in good quantities, they will be well below the strength of the 1968 year-class of spring-spawners.

The use of purse seine catch rate data appears to becoming more and more difficult to use both through the schooling behaviour of herring and changes in the operation of the fleet. The use of fixed gear effort appears to be promising and less subject to variation in consistency due to the large numbers of individuals involved and the extended periods for which they operate.

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Table 1. Newfoundland west coast herring catches (m tons)
1966-80.

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 ¹	(5100)	(6939)	(3394)	(3563)	(18996)

¹ provisional data.

Table 2. Herring catches (mt) 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 ¹	3481	1619	3704	3235	2458	936	-	3563	9643	9353	18996

¹ provisional data.

Table 3. Catch matrix Newfoundland west coast ($\times 10^{-3}$).

Spawning group	Age group	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980*
Spring-spawners	2	212	3377	1	405	211	62	117	509	11	1	117	307
	3	1109	1565	3076	265	98	113	951	994	666	45	30	978
	4	1525	386	282	6332	764	26	525	983	538	2012	211	84
	5	341	545	589	751	16215	201	293	230	530	222	11498	326
	6	318	237	289	806	1270	5548	1541	332	305	703	551	14864
	7	176	195	150	940	2873	146	8410	2820	364	248	1013	413
	8	441	240	307	208	1311	773	235	15555	4226	2241	497	1306
	9	963	988	92	499	1404	484	366	777	16452	8479	2707	263
	10	368	952	315	135	806	58	138	2858	934	16460	7189	998
	11+	445	1680	797	1094	4272	2041	701	3229	5666	5164	14233	21778
Total		5898	10165	5898	11435	29224	9452	13277	28287	29692	35575	38046	41317
Autumn-spawners	2	17	1	30	12	1	1	1	1	1	1	1	19
	3	299	770	1	81	292	12	94	63	3	10	32	254
	4	531	141	2	93	466	141	183	51	61	30	120	84
	5	272	145	55	69	628	110	1188	119	118	407	312	144
	6	613	214	343	248	585	57	350	338	298	296	2592	254
	7	517	468	950	326	973	117	83	462	727	1018	606	1511
	8	157	177	2058	422	1040	58	112	105	373	1608	1410	217
	9	119	129	1093	893	2223	195	70	157	207	482	1929	675
	10	168	239	714	256	2016	205	59	50	95	298	537	273
	11+	1254	2122	7583	6265	8975	2161	1842	3742	6926	5018	6496	4838
Total		3947	4406	12829	8665	17199	3057	3982	5088	8809	9168	14035	8269

* based on provisional catch data.

Table 4. A comparison of data used to derive partial recruitment rates in 1980 and the PR values used in the previous assessment.

Spawning type	Age	PR 1979	%-at-age Res. G.N.	%-at-age PS Spring	%-at-age PS Autumn	\bar{F} 1976-78	%-at-age total* %-at-age Res. G.N.	PR 1980
Spring-spawners	2	0.05	3.4	0.3	4.7	.007	.129	0.10
	3	0.10	26.1	2.8	6.3	.185 (0.28) ¹	.057	0.20
	4	0.15	1.4	0.1	0.2	.210 (.125) ¹	.089	0.30
	5	0.25	1.4	1.0	0.4	.172	.357	0.60
	6	0.40	22.3	39.4	26.0	.195	1.0	1.00
	7	0.60	1.4	1.0	0.1	.164	.446	1.00
	8	0.95	2.9	3.0	2.8	.362	.668	1.00
	9	1.00	1.3	0.5	0.3	.377	.289	1.00
	10	1.00	2.7	2.1	1.0	.477	.555	1.00
	11	1.00	37.1	49.7	58.3	.477	.894	1.00
				(N = 560)				
Autumn-spawners	2	0.01	-	-	1.9	0.0		0.01
	3	0.05	-	-	25.8	.006		0.05
	4	0.10	-	3.8	0.8	.025		0.10
	5	0.20	17.6	1.9	3.4	.086		0.20
	6	0.30	23.6	1.9	4.4	.070		0.50
	7	0.45	29.4	32.8	15.1	.349		1.00
	8	0.65	-	15.3	1.8	.450		1.00
	9	1.00	5.9	3.8	7.5	.392		1.00
	10	1.00	5.9	5.7	-	.341		1.00
	11	1.00	17.6	34.6	39.2	.304		1.00
				(N = 17)				

* standardized to age 6.

¹ These figures based on 2 yrs. data as 1 value appeared anomalous.

Table 5. Effort data for the Newfoundland west coast fishery based on data from the purse seine fleet.

Year	Total Catch (mt)	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	(89.0) ¹	227.9	(175.4) ¹
1979	18321	73.5	54.2	249.3	338.0
1980	18996	106.5	62.9	178.4	302.0

¹ from landing slips

Table 6. Gillnet catch rates (t/landing) from Area N by month as derived from sales slips.

Year	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Oct.-Nov. unweighted	East Coast ¹ AF	Oct.-Nov. ¹ adjusted
1977	-	0.34	0.77	0.62	0.43	1.04	0.82	0.74	1.00	0.74
1978	0.62	0.75	0.66	0.59	0.63	0.79	-	0.71	1.10	0.65
1979	0.44	0.46	0.69	0.39	0.43	0.58	0.65	0.51	1.27	0.40
1980			0.64	0.62	0.37	0.51	0.17	0.44	1.45	0.30

¹ John Wheeler, pers. comm. - adjustment factors to compensate for increase in numbers of nets fished per man.

Table 7. Data from the gillnet fishery in statistical area N for 1977-80 and calculated Paloheimo Z values. Combined Z weighted by percent spawning type in the monthly sample.

Year	Month	Catch	CPUE	Effort	% spawning type		Adj. Factor	adj. Paloheimo Z			
					AS	SS		AS	SS	Combined	
1977	July	340	0.34	1000	67	33	1.00	-0.51	-0.62	-0.55 }	}-- 1977-78
	Aug.	577	0.77	723	98	2	1.00	0.37	-1.25	0.31 }	
	Sept.	157	0.62	253	72	28	1.00	0.50	0.41	0.47 }	
	Oct.	366	0.43	851	43	57	1.00	-0.20	-0.11	-0.08 }	
	Nov.	546	1.04	525	21	79	1.00	0.56	0.60	0.59 }	
1978	July	695	0.75	927	66	34	1.10	0.67	0.99	0.78 }	}-- 1978-79
	Aug.	1147	0.66	1738	(96)	(4) ¹	1.10	0.20	-0.62	0.17 }	
	Sept.	645	0.59	1093	(62)	(38) ¹	1.10	0.41	0.15	0.31 }	
	Oct.	725	0.63	1151	(38)	(62) ¹	1.10	0.39	0.89	0.70 }	
	Nov.	483	0.79	611	21	79	1.10	0.31	0.73	0.62 }	
1979	July	783	0.46	1702	60	40	1.27				}-- 1979-80
	Aug.	1010	0.69	1464	89	11	1.27	0.21	0	0.20 }	
	Sept.	307	0.39	787	61	39	1.27	0	-0.39	-0.15 }	
	Oct.	270	0.43	628	47	53	1.27	1.05	0.08	0.45 }	
	Nov.	533	0.58	919	(26)	(74) ¹	1.27	0.07	0.66	0.51 }	
1980	July	834			67	33	1.45				
	Aug.	1676	0.64	2619	100	0	1.45				
	Sept.	477	0.62	769	54	46	1.45				
	Oct.	98	0.37	265	24	76	1.45				
	Nov.	241	0.51	473	37	63	1.45				

¹ average monthly percent.

Table 8. Population biomass and mortalities from cohort analysis F_T AS = 0.33, F_T SS = 0.28.

		1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981
Biomass 2+ ($\times 10^{-3}$ t)	AS	232.9	199.0	163.8	135.7	110.0	92.9	75.4	56.7	39.7	26.0	15.0	11.4
	SS	141.7	183.2	201.4	195.6	174.7	154.7	145.5	126.3	104.9	84.3	63.2	42.9
	Total	374.6	382.2	365.2	331.3	284.7	247.6	220.9	183.0	144.6	110.3	78.2	54.3
Biomass 5+	AS	230.4	195.0	159.1	130.1	104.8	88.9	72.3	53.3	38.5	24.0	12.3	8.1
	SS	57.1	67.1	63.1	148.6	165.3	149.5	126.9	104.6	80.7	81.6	59.2	38.1
	Total	287.5	262.1	222.2	278.7	270.1	238.4	199.2	157.9	119.2	105.6	71.5	46.2
F_{5-18}	AS	.006	.029	.024	.058	.011	.019	.029	.066	.115	.361	.283	
	SS	.031	.013	.025	.057	.017	.026	.072	.101	.166	.175	.278	

Table 9. Population estimates of spring- and autumn-spawning herring from the Newfoundland west coast. $F_T = 0.28$ for spring-spawners and 0.33 for autumn-spawners.

Spawning group		Year											
		1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981
Spring-spawners	2	7492	3060	457	98	283	92	1767	46	18	243	123	50
	3	375	6103	2505	371	79	231	74	1442	38	14	198	98
	4	1006	293	4969	2049	302	63	181	52	1175	31	11	153
	5	234	820	237	4011	1670	247	47	139	38	943	23	9
	6	62	187	666	187	3137	1366	200	36	109	29	668	16
	7	172	48	150	538	142	2518	1104	161	27	83	19	414
	8	98	139	38	114	415	115	1986	879	128	20	59	11
	9	231	78	111	29	82	332	92	1485	681	85	12	36
	10	358	180	63	86	11	63	269	68	1067	481	45	7
	11+	598	759	759	662	566	454	408	490	386	977	979	634
	N_t ($\times 10^{-5}$)	10626	11667	9955	8145	6687	5481	6128	4798	3667	2906	2137	1428
Autumn-spawners	2	144	186	259	202	58	234	48	47	43	209	64	50
	3	63	118	152	212	165	48	192	39	39	35	171	52
	4	61	45	97	124	171	135	38	156	32	32	29	138
	5	111	48	37	78	97	138	109	31	127	26	25	23
	6	270	90	39	30	58	78	103	88	24	101	18	19
	7	479	219	70	30	19	47	61	81	70	17	59	13
	8	97	388	171	55	16	14	38	46	60	48	8	35
	9	179	78	299	136	35	12	11	30	34	34	26	5
	10	868	146	54	237	91	27	9	7	23	24	11	16
	11+	3969	3939	3269	2661	2273	1914	1510	1073	692	400	189	117
	N_t ($\times 10^{-5}$)	6241	5257	4447	3765	2983	2647	2119	1598	1144	926	600	468

Table 10. Input parameters for stock projection.

Age	Spring-spawners		Autumn-spawners	
	PR	Ave. wgt. (grams)	PR	Ave. wgt. (grams)
2	.10	79	.01	50
3	.20	141	.05	113
4	.30	200	.10	176
5	.60	239	.20	222
6	1.00	269	.50	256
7	1.00	292	1.00	294
8	1.00	307	1.00	322
9	1.00	324	1.00	340
10	1.00	335	1.00	352
11	1.00	372	1.00	421
F _{0.1}		0.345		0.381

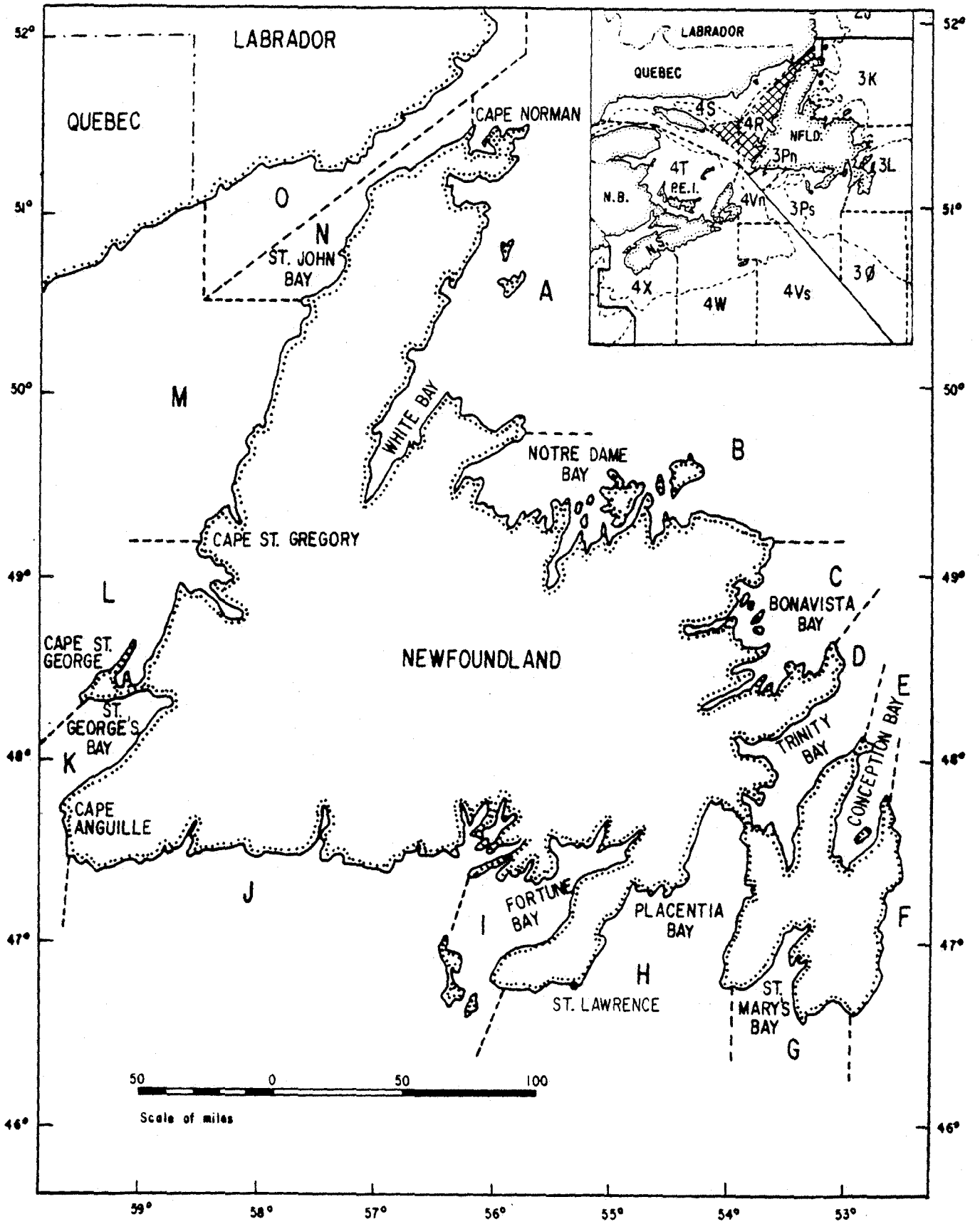


Fig. 1. Newfoundland area map.

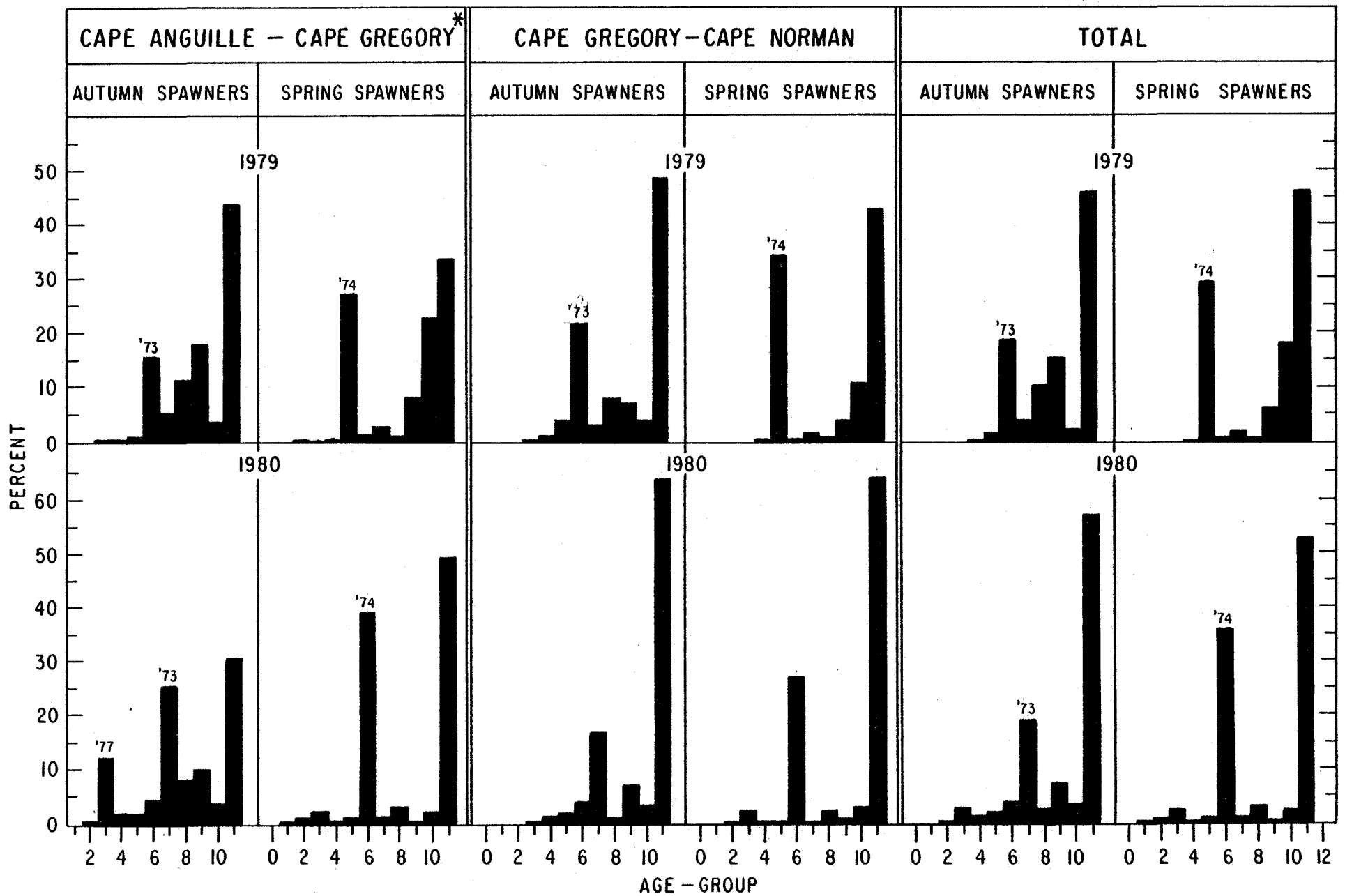


Fig. 2. Age frequency distribution of the herring catches from the Newfoundland West Coast Herring Stock for 1979 and 1980. * includes Shag Island fishery in December 1980.

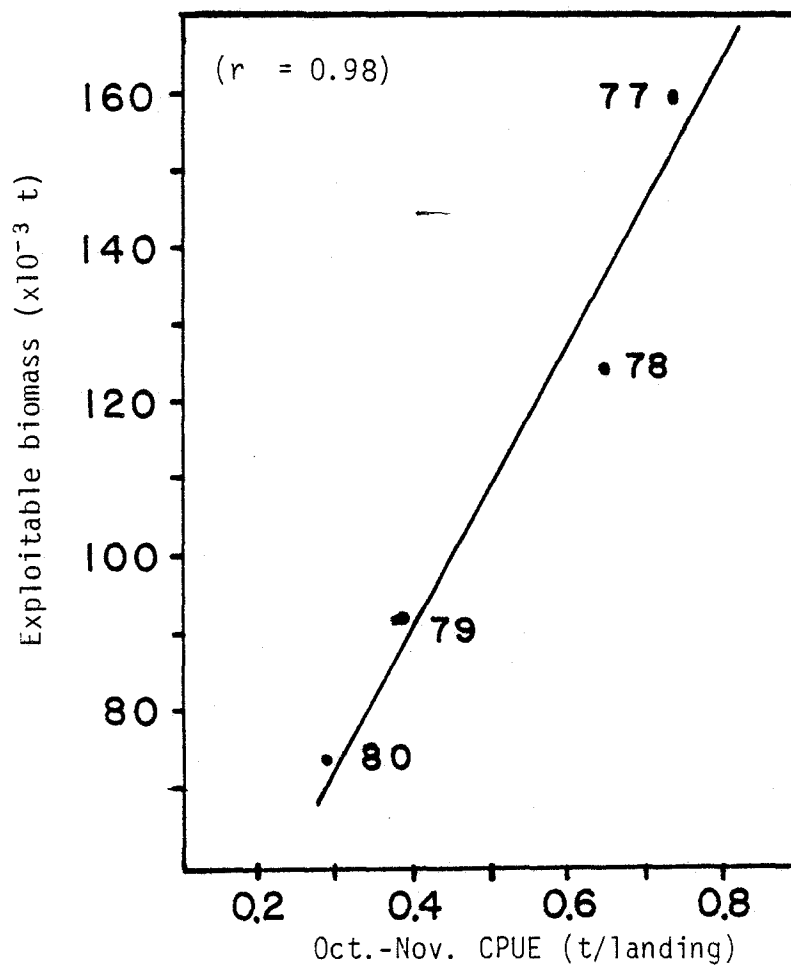


Fig. 3. Relationship of unweighted mean gillnet catch per landing for October-November (adjusted for changes in effort) and exploitable biomass of spring- and autumn-spawners combined for the period 1977-80.

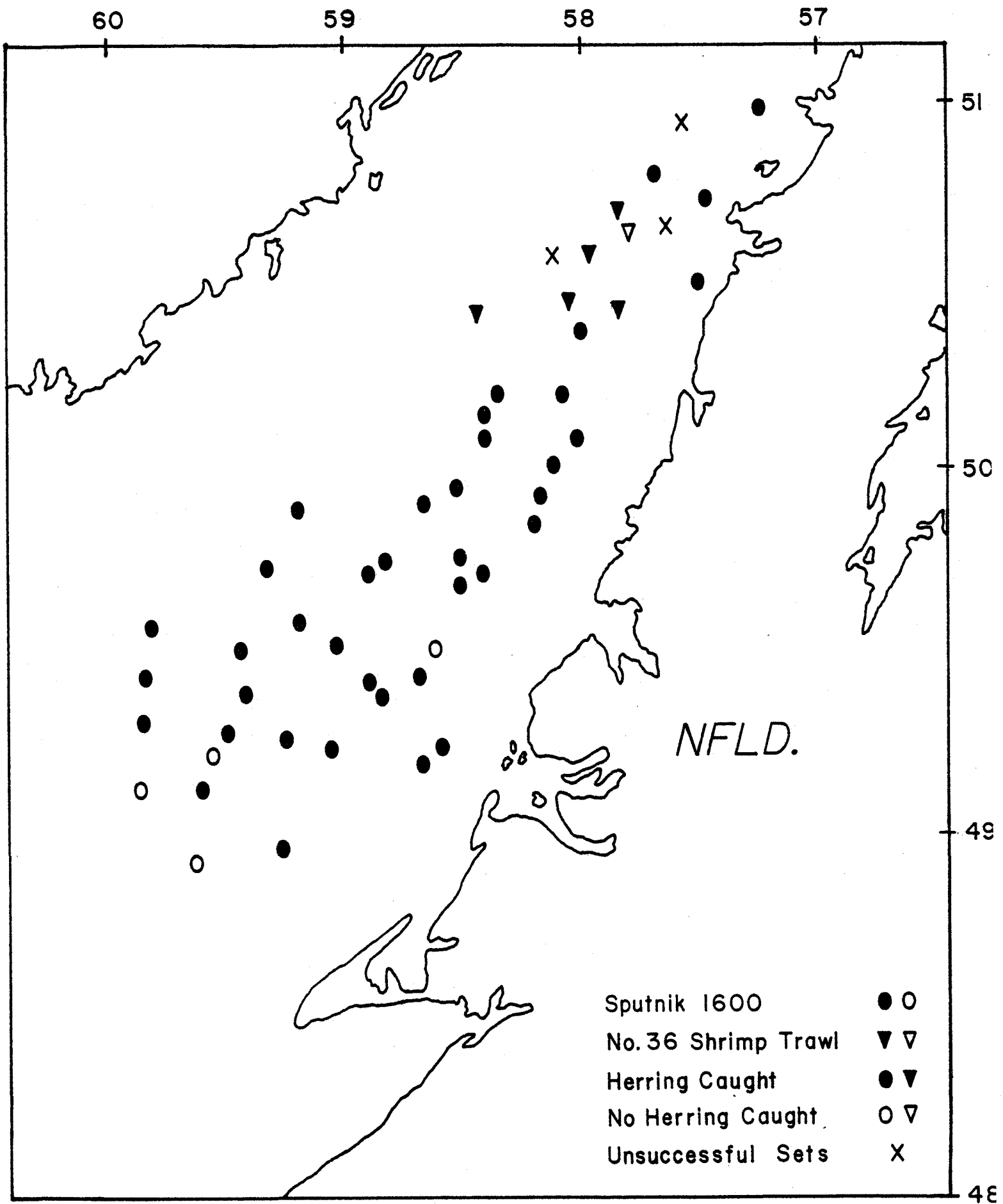


Fig. 4. Results of the pelagic survey conducted by the MV Martin and Phillip during January 1981.

Appendix 1: Spring-spawners

1. Average weights-at-age
2. Catch matrix
3. F matrix
4. Population matrix $F_T = 0.28$
5. Stock projection 1981
6. Stock projection 1982

MEAN WEIGHTS

AGE/YEAR	1966	1967	1968	1969	1970	1971	1972	1973
2	76.000	76.000	76.000	76.000	76.000	76.000	76.000	88.000
3	150.000	150.000	150.000	150.000	150.000	150.000	196.000	157.000
4	196.000	196.000	196.000	196.000	196.000	196.000	203.000	194.000
5	225.000	225.000	225.000	225.000	225.000	215.000	210.000	204.000
6	257.000	257.000	257.000	257.000	257.000	250.000	275.000	250.000
7	278.000	278.000	278.000	278.000	278.000	278.000	277.000	309.000
8	296.000	296.000	296.000	296.000	296.000	296.000	279.000	324.000
9	322.000	322.000	322.000	322.000	322.000	322.000	317.000	351.000
10	333.000	333.000	333.000	333.000	333.000	334.000	346.000	370.000
11	363.000	363.000	363.000	363.000	363.000	370.000	363.000	389.000
12	363.000	363.000	363.000	363.000	363.000	370.000	363.000	389.000
13	363.000	363.000	363.000	363.000	363.000	370.000	363.000	389.000
14	363.000	363.000	363.000	363.000	363.000	370.000	363.000	389.000
15	363.000	363.000	363.000	363.000	363.000	370.000	363.000	389.000
16	363.000	363.000	363.000	363.000	363.000	370.000	363.000	389.000
17	363.000	363.000	363.000	363.000	363.000	370.000	363.000	389.000
18	363.000	363.000	363.000	363.000	363.000	370.000	363.000	389.000
19	363.000	363.000	363.000	363.000	363.000	370.000	363.000	389.000
20	363.000	363.000	363.000	363.000	363.000	370.000	363.000	389.000
AGE/YEAR	1974	1975	1976	1977	1978	1979	1980	
2	76.000	72.000	71.000	64.000	76.000	87.000	98.000	
3	150.000	149.000	135.000	122.000	167.000	125.000	158.000	
4	196.000	196.000	177.000	194.000	172.000	234.000	221.000	
5	225.000	233.000	227.000	219.000	247.000	241.000	261.000	
6	240.000	237.000	238.000	250.000	279.000	287.000	291.000	
7	299.000	270.000	259.000	252.000	289.000	319.000	341.000	
8	313.000	300.000	290.000	267.000	292.000	334.000	351.000	
9	318.000	334.000	310.000	289.000	314.000	340.000	367.000	
10	333.000	339.000	319.000	297.000	328.000	357.000	375.000	
11	371.000	392.000	380.000	338.000	344.000	389.000	409.000	
12	371.000	392.000	380.000	338.000	344.000	389.000	409.000	
13	371.000	392.000	380.000	338.000	344.000	389.000	409.000	
14	371.000	392.000	380.000	338.000	344.000	389.000	409.000	
15	371.000	392.000	380.000	338.000	344.000	389.000	409.000	
16	371.000	392.000	380.000	338.000	344.000	389.000	409.000	
17	371.000	392.000	380.000	338.000	344.000	389.000	409.000	
18	371.000	392.000	380.000	338.000	344.000	389.000	409.000	
19	371.000	392.000	380.000	338.000	344.000	389.000	409.000	
20	371.000	392.000	380.000	338.000	344.000	389.000	409.000	

C A T C H M A T R I X

SPINNING SPIDERS

AGE/YEAR	1966	1967	1968	1969	1970	1971	1972	1973
2	173.	1.	101.	212.	3377.	1.	405.	211.
3	358.	9.	359.	1109.	1565.	3076.	265.	98.
4	280.	338.	200.	1525.	386.	282.	6332.	764.
5	551.	60.	475.	341.	545.	589.	751.	16215.
6	1932.	264.	128.	318.	237.	289.	806.	1270.
7	3890.	3392.	561.	176.	195.	150.	940.	2873.
8	2032.	2704.	1231.	441.	240.	307.	208.	1311.
9	1575.	1162.	2237.	963.	988.	92.	499.	1404.
10	292.	769.	416.	368.	952.	315.	135.	806.
11	482.	322.	204.	219.	760.	289.	310.	469.
12	1.	531.	85.	107.	453.	230.	284.	1079.
13	1.	1.	141.	45.	221.	137.	226.	987.
14	1.	1.	1.	74.	93.	67.	135.	786.
15	1.	1.	1.	1.	153.	28.	66.	469.
16	1.	1.	1.	1.	1.	46.	28.	229.
17	1.	1.	1.	1.	1.	1.	45.	97.
18	1.	1.	1.	1.	1.	1.	1.	156.
19	1.	1.	1.	1.	1.	1.	1.	1.
20	1.	1.	1.	1.	1.	1.	1.	1.

AGE/YEAR	1974	1975	1976	1977	1978	1979	1980
2	62.	117.	509.	11.	1.	117.	307.
3	113.	951.	994.	666.	45.	30.	1023.
4	26.	525.	983.	538.	2012.	211.	106.
5	201.	293.	230.	530.	222.	11498.	326.
6	5548.	1541.	332.	305.	703.	551.	15501.
7	146.	8410.	2820.	364.	248.	1013.	413.
8	773.	235.	15555.	4226.	2241.	497.	1330.
9	484.	366.	777.	16452.	8479.	2707.	270.
10	58.	138.	2858.	934.	16460.	7189.	1046.
11	324.	19.	531.	2660.	731.	10834.	7733.
12	189.	108.	74.	495.	2082.	481.	11653.
13	434.	63.	416.	69.	387.	1370.	517.
14	397.	145.	242.	387.	54.	255.	1474.
15	316.	133.	558.	225.	303.	36.	274.
16	189.	106.	512.	519.	176.	199.	39.
17	92.	63.	408.	477.	406.	116.	214.
18	38.	31.	242.	380.	373.	267.	125.
19	62.	13.	119.	225.	297.	246.	287.
20	1.	20.	127.	229.	355.	429.	726.

HERRING AREA KLMN SS
FISHING MORTALITIES

AGE/YEAR	1966	1967	1968	1969	1970	1971	1972	1973
2	.013	.000	.001	.005	.005	.000	.010	.024
3	.010	.001	.010	.010	.046	.005	.001	.003
4	.013	.011	.022	.056	.004	.010	.014	.004
5	.011	.004	.020	.048	.026	.008	.035	.044
6	.023	.007	.009	.016	.043	.017	.013	.076
7	.061	.052	.017	.016	.012	.034	.070	.059
8	.057	.054	.024	.017	.027	.024	.061	.132
9	.081	.041	.058	.023	.047	.013	.050	.733
10	.029	.052	.019	.012	.029	.019	.023	.106
11	.063	.041	.017	.012	.031	.011	.023	.106
12	.010	.091	.013	.011	.032	.012	.013	.106
13	.019	.012	.031	.009	.029	.012	.014	.058
14	.007	.024	.015	.021	.022	.011	.015	.063
15	.007	.009	.030	.019	.054	.008	.013	.064
16	.020	.009	.011	.038	.023	.021	.010	.058
17	.025	.025	.011	.013	.048	.029	.025	.045
18	.031	.031	.031	.013	.016	.063	.037	.115
19	.039	.039	.039	.039	.016	.020	.082	.047
20	.050	.050	.050	.050	.050	.020	.025	.110

AGE/YEAR	1974	1975	1976	1977	1978	1979	1980
2	.002	.014	.003	.003	.001	.005	.028
3	.016	.046	.160	.005	.013	.019	.056
4	.001	.095	.061	.122	.018	.079	.084
5	.001	.013	.055	.042	.067	.139	.168
6	.019	.012	.018	.095	.073	.238	.280
7	.011	.036	.028	.025	.105	.143	.280
8	.020	.022	.088	.052	.209	.315	.280
9	.066	.012	.095	.126	.142	.419	.280
10	.056	.024	.121	.158	.179	.171	.280
11	.057	.023	.121	.158	.179	.171	.280
12	.057	.024	.119	.158	.179	.172	.280
13	.057	.024	.121	.156	.179	.171	.280
14	.030	.024	.121	.158	.176	.172	.280
15	.033	.012	.121	.158	.179	.170	.280
16	.033	.014	.061	.158	.179	.172	.280
17	.030	.014	.067	.074	.179	.171	.280
18	.022	.013	.067	.082	.076	.172	.280
19	.061	.009	.061	.082	.085	.066	.280
20	.060	.025	.120	.160	.180	.170	.280

HERRING AREA KLMN SS
POPULATION NUMBERS

AGE/YEAR	1966	1967	1968	1969	1970	1971	1972	1973
2	15123.	46516.	155683.	47141.	770435.	317517.	46775.	9957.
3	41351.	12225.	38083.	127371.	38404.	627723.	259960.	37930.
4	23210.	33531.	10001.	30855.	103279.	30026.	511153.	212597.
5	55349.	18749.	27147.	8007.	23882.	84208.	24328.	412767.
6	93251.	44817.	15296.	21797.	6247.	19060.	68411.	19239.
7	73118.	74599.	36454.	12408.	17558.	4900.	15343.	55281.
8	40872.	56344.	58008.	29339.	9999.	14199.	3876.	11711.
9	22408.	31625.	43684.	46379.	23621.	7970.	11347.	2986.
10	11271.	16921.	24841.	33741.	37100.	18446.	6442.	8839.
11	8754.	8964.	13158.	19961.	27292.	29514.	14817.	5152.
12	113.	6731.	7048.	10588.	16145.	21657.	23902.	11851.
13	58.	92.	5030.	5693.	8572.	12808.	17523.	19313.
14	160.	47.	74.	3991.	4621.	6818.	10363.	14142.
15	160.	130.	37.	60.	3200.	3699.	5522.	8362.
16	56.	130.	106.	30.	48.	2482.	3003.	4461.
17	45.	45.	106.	85.	23.	39.	1990.	2433.
18	36.	36.	36.	86.	69.	18.	31.	1589.
19	29.	29.	29.	29.	69.	56.	14.	24.
20	23.	23.	23.	23.	23.	56.	45.	11.
AGE/YEAR	1974	1975	1976	1977	1978	1979	1980	
2	28670.	9209.	183067.	4647.	2204.	25419.	12262.	
3	7961.	23417.	7434.	149422.	3795.	1804.	20706.	
4	30966.	6416.	18311.	5187.	121734.	3066.	1450.	
5	173369.	25329.	4778.	14103.	3760.	97847.	2319.	
6	323273.	141760.	20473.	3704.	11067.	2877.	69706.	
7	14602.	259654.	114669.	16461.	2756.	8425.	1857.	
8	42661.	11823.	204977.	91332.	13148.	2032.	5981.	
9	8402.	34228.	9467.	153746.	70952.	8737.	1214.	
10	1174.	6441.	27692.	7048.	110990.	50419.	4704.	
11	6507.	909.	5149.	20087.	4925.	75978.	34774.	
12	3794.	5034.	727.	3735.	14039.	3371.	52402.	
13	8726.	2935.	4024.	528.	2610.	9610.	2325.	
14	14919.	6752.	2346.	2918.	370.	1787.	6628.	
15	10868.	11855.	5397.	1702.	2039.	254.	1232.	
16	6422.	8612.	9586.	3913.	1190.	1395.	175.	
17	3445.	5087.	6955.	7385.	2734.	815.	962.	
18	1904.	2737.	4108.	5325.	5615.	1871.	562.	
19	1160.	1525.	2213.	3144.	4016.	4259.	1291.	
20	19.	893.	1237.	1704.	2371.	3019.	3265.	

HERRING AREA KLMN SS
CATCH PROJECTION FOR 1981

AGE	POPULATION NUMBERS	POPULATION WEIGHT	FISHING MORTALITY	CATCH NUMBERS	CATCH WEIGHT	RESIDUAL NUMBERS	RESIDUAL WEIGHT
2	5000.	395.	.034	154.	12.	3955.	312.
3	9762.	1376.	.069	591.	83.	7459.	1052.
4	16029.	3206.	.104	1431.	286.	11833.	2367.
5	1091.	261.	.207	186.	44.	726.	174.
6	1605.	432.	.345	427.	115.	931.	250.
7	43133.	12595.	.345	11472.	3350.	25010.	7303.
8	1149.	353.	.345	306.	94.	666.	205.
9	3701.	1199.	.345	984.	319.	2146.	695.
10	751.	252.	.345	200.	67.	436.	146.
11	2911.	1083.	.345	774.	288.	1688.	628.
12	21518.	8005.	.345	5723.	2129.	12477.	4641.
13	32426.	12062.	.345	8624.	3208.	18802.	6994.
14	1439.	535.	.345	383.	142.	834.	310.
15	4102.	1526.	.345	1091.	406.	2378.	885.
16	762.	284.	.345	203.	75.	442.	164.
17	109.	40.	.345	29.	11.	63.	23.
18	595.	222.	.345	158.	59.	345.	128.
19	348.	129.	.345	93.	34.	202.	75.
20	2819.	1049.	.345	750.	279.	1634.	608.
TOTAL	149249.	45002.		33577.	11002.	92028.	26961.

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.	395.	.034	154.	12.	3955.	312.
3	3955.	558.	.069	239.	34.	3022.	426.
4	7459.	1492.	.104	666.	133.	5507.	1101.
5	11833.	2828.	.207	2012.	481.	7877.	1883.
6	726.	195.	.345	193.	52.	421.	113.
7	931.	272.	.345	248.	72.	540.	158.
8	25010.	7678.	.345	6652.	2042.	14502.	4452.
9	666.	216.	.345	177.	57.	386.	125.
10	2146.	719.	.345	571.	191.	1244.	417.
11	436.	162.	.345	116.	43.	253.	94.
12	1688.	628.	.345	449.	167.	979.	364.
13	12477.	4641.	.345	3319.	1234.	7235.	2691.
14	18802.	6994.	.345	5001.	1860.	10902.	4056.
15	834.	310.	.345	222.	83.	484.	180.
16	2378.	885.	.345	633.	235.	1379.	513.
17	442.	164.	.345	118.	44.	256.	95.
18	63.	23.	.345	17.	6.	36.	14.
19	345.	128.	.345	92.	34.	200.	74.
20	1836.	683.	.345	488.	182.	1065.	396.
TOTAL	97028.	28973.		21365.	6964.	60242.	17465.

Appendix 2: Autumn-spawners

1. Average weights-at-age
2. Catch matrix
3. F matrix
4. Population matrix $F_T = 0.33$
5. Stock projection 1981
6. Stock projection 1982

MEAN WEIGHTS

HUTGAIN SPHWNERS

1

AGE/YEAR	1966	1967	1968	1969	1970	1971	1972	1973
2	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
4	174.000	174.000	174.000	174.000	174.000	174.000	174.000	181.000
5	226.000	226.000	226.000	226.000	226.000	226.000	226.000	254.000
6	253.000	253.000	253.000	253.000	253.000	272.000	238.000	293.000
7	284.000	284.000	284.000	284.000	284.000	308.000	239.000	306.000
8	307.000	307.000	307.000	307.000	307.000	328.000	275.000	315.000
9	319.000	319.000	319.000	319.000	319.000	362.000	280.000	324.000
10	337.000	337.000	337.000	337.000	337.000	378.000	287.000	349.000
11	405.000	405.000	405.000	405.000	405.000	448.000	376.000	362.000
12	405.000	405.000	405.000	405.000	405.000	448.000	376.000	362.000
13	405.000	405.000	405.000	405.000	405.000	448.000	376.000	362.000
14	405.000	405.000	405.000	405.000	405.000	448.000	376.000	362.000
15	405.000	405.000	405.000	405.000	405.000	448.000	376.000	362.000
16	405.000	405.000	405.000	405.000	405.000	448.000	376.000	362.000
17	405.000	405.000	405.000	405.000	405.000	448.000	376.000	362.000
18	405.000	405.000	405.000	405.000	405.000	448.000	376.000	362.000
19	405.000	405.000	405.000	405.000	405.000	448.000	376.000	362.000
20	405.000	405.000	405.000	405.000	405.000	448.000	376.000	362.000

AGE/YEAR	1974	1975	1976	1977	1978	1979	1980
2	50.000	50.000	50.000	50.000	50.000	50.000	50.000
3	120.000	114.000	91.000	120.000	120.000	114.000	122.000
4	215.000	164.000	156.000	163.000	174.000	165.000	224.000
5	225.000	221.000	190.000	224.000	228.000	239.000	229.000
6	235.000	248.000	240.000	231.000	252.000	270.000	287.000
7	284.000	273.000	255.000	258.000	315.000	321.000	321.000
8	307.000	278.000	307.000	277.000	319.000	348.000	357.000
9	319.000	305.000	319.000	319.000	323.000	361.000	380.000
10	376.000	372.000	337.000	337.000	337.000	370.000	381.000
11	415.000	432.000	393.000	382.000	418.000	415.000	497.000
12	415.000	432.000	393.000	382.000	418.000	415.000	497.000
13	415.000	432.000	393.000	382.000	418.000	415.000	497.000
14	415.000	432.000	393.000	382.000	418.000	415.000	497.000
15	415.000	432.000	393.000	382.000	418.000	415.000	497.000
16	415.000	432.000	393.000	382.000	418.000	415.000	497.000
17	415.000	432.000	393.000	382.000	418.000	415.000	497.000
18	415.000	432.000	393.000	382.000	418.000	415.000	497.000
19	415.000	432.000	393.000	382.000	418.000	415.000	497.000
20	415.000	432.000	393.000	382.000	418.000	415.000	497.000

C A T C H M A T R I X : H E T U M N S P A W N E R S

AGE/YEAR	1966	1967	1968	1969	1970	1971	1972	1973
2	111.	1.	1.	17.	1.	30.	12.	1.
3	195.	29.	228.	299.	770.	1.	81.	292.
4	632.	51.	131.	531.	141.	2.	93.	466.
5	273.	542.	206.	272.	145.	55.	69.	628.
6	271.	314.	1050.	613.	214.	343.	248.	585.
7	273.	119.	295.	517.	468.	950.	326.	973.
8	996.	332.	224.	157.	177.	2058.	422.	1040.
9	1091.	953.	292.	119.	129.	1093.	893.	2223.
10	914.	1151.	1219.	168.	239.	714.	256.	2016.
11	2749.	803.	669.	407.	251.	768.	539.	352.
12	1.	2414.	467.	223.	607.	806.	580.	742.
13	1.	1.	1402.	156.	333.	1950.	609.	798.
14	1.	1.	1.	468.	233.	1070.	1472.	838.
15	1.	1.	1.	1.	698.	748.	808.	2026.
16	1.	1.	1.	1.	1.	2241.	565.	1112.
17	1.	1.	1.	1.	1.	1.	1692.	778.
18	1.	1.	1.	1.	1.	1.	1.	2329.
19	1.	1.	1.	1.	1.	1.	1.	1.
20	1.	1.	1.	1.	1.	1.	1.	1.
	1974	1975						
AGE/YEAR	1974	1975	1976	1977	1978	1979	1980	
2	1.	1.	1.	1.	1.	1.	19.	
3	12.	94.	63.	3.	10.	32.	254.	
4	141.	183.	51.	61.	30.	120.	134.	
5	110.	1188.	119.	118.	407.	312.	169.	
6	57.	350.	338.	298.	296.	2592.	354.	
7	117.	83.	462.	727.	1018.	606.	1661.	
8	58.	112.	105.	373.	1608.	1410.	217.	
9	195.	70.	157.	207.	482.	1929.	675.	
10	205.	59.	50.	95.	298.	537.	298.	
11	396.	160.	117.	92.	68.	364.	388.	
12	69.	308.	315.	214.	66.	83.	262.	
13	146.	54.	606.	575.	153.	81.	60.	
14	157.	114.	106.	1107.	411.	188.	58.	
15	165.	122.	224.	194.	791.	502.	135.	
16	398.	128.	240.	409.	139.	967.	361.	
17	219.	310.	252.	438.	292.	170.	696.	
18	153.	171.	610.	460.	313.	357.	122.	
19	458.	119.	337.	1114.	329.	382.	257.	
20	1.	356.	935.	2323.	2456.	3402.	2724.	

3

HERKING AREA KLMN AS
FISHING MORTALITIES

AGE/YEAR	1966	1967	1968	1969	1970	1971	1972	1973
2	.002	.000	.000	.002	.000	.002	.001	.000
3	.002	.001	.014	.043	.142	.000	.006	.015
4	.027	.001	.004	.042	.026	.000	.010	.042
5	.007	.029	.003	.009	.014	.013	.021	.091
6	.001	.010	.073	.011	.009	.042	.072	.243
7	.001	.001	.012	.047	.011	.048	.052	.442
8	.004	.002	.002	.008	.020	.059	.027	.232
9	.006	.005	.002	.001	.008	.167	.033	.195
10	.007	.008	.008	.001	.003	.055	.053	.097
11	.036	.008	.006	.003	.003	.012	.053	.096
12	.005	.040	.005	.002	.006	.011	.011	.096
13	.017	.006	.029	.002	.004	.023	.010	.018
14	.014	.022	.007	.012	.004	.018	.022	.017
15	.016	.017	.027	.009	.023	.016	.017	.038
16	.011	.020	.021	.034	.011	.095	.015	.029
17	.025	.013	.025	.027	.043	.013	.096	.026
18	.019	.031	.016	.031	.034	.055	.016	.186
19	.024	.024	.039	.020	.039	.043	.072	.020
20	.030	.030	.030	.050	.025	.050	.055	.095
AGE/YEAR	1974	1975	1976	1977	1978	1979	1980	
2	.000	.000	.000	.000	.000	.000	.003	
3	.001	.022	.003	.001	.002	.006	.016	
4	.009	.015	.015	.004	.008	.037	.033	
5	.012	.098	.012	.043	.034	.105	.066	
6	.011	.049	.036	.038	.146	.309	.165	
7	.070	.019	.085	.102	.176	.499	.330	
8	.041	.088	.030	.092	.343	.395	.330	
9	.062	.064	.171	.077	.164	.916	.330	
10	.025	.024	.060	.149	.151	.278	.330	
11	.025	.024	.060	.148	.151	.279	.330	
12	.025	.024	.060	.149	.151	.278	.330	
13	.025	.024	.060	.149	.151	.280	.330	
14	.004	.024	.060	.149	.151	.280	.330	
15	.004	.004	.060	.149	.151	.279	.330	
16	.009	.004	.010	.149	.151	.279	.330	
17	.007	.009	.010	.023	.151	.280	.330	
18	.006	.007	.022	.022	.021	.279	.330	
19	.050	.006	.016	.051	.019	.032	.330	
20	.025	.050	.060	.150	.150	.280	.330	

HERRING AREA KLMN AS
P O P U L A T I O N N U M B E R S

AGE/YEAR	1966	1967	1968	1969	1970	1971	1972	1973
2	61969.	21754.	9539.	7872.	14746.	19013.	26355.	20210.
3	110428.	50635.	17810.	7809.	6430.	12072.	15539.	21567.
4	26033.	90235.	41431.	14375.	6123.	4567.	9883.	12649.
5	42132.	20742.	73832.	33802.	11289.	4886.	3738.	8007.
6	202047.	34248.	16492.	60262.	27429.	9111.	3950.	2998.
7	228985.	165177.	27756.	12552.	48784.	22263.	7149.	3010.
8	261303.	187230.	135128.	22457.	9809.	39517.	17368.	5559.
9	187038.	213035.	152991.	110431.	18245.	7871.	30492.	13838.
10	143954.	152147.	173556.	124994.	90305.	14821.	5455.	24157.
11	85835.	117033.	123526.	140993.	102184.	73719.	11488.	4235.
12	241.	67788.	95092.	100529.	115067.	83434.	59661.	8918.
13	65.	196.	53316.	77432.	82104.	93660.	67581.	48322.
14	80.	52.	160.	42383.	63255.	66920.	74918.	54780.
15	70.	65.	42.	130.	34277.	51578.	53821.	60005.
16	106.	56.	52.	33.	106.	27432.	41552.	43334.
17	45.	85.	45.	42.	26.	85.	20432.	33508.
18	58.	36.	69.	36.	33.	21.	69.	15197.
19	47.	47.	29.	56.	29.	26.	16.	56.
20	37.	37.	37.	23.	45.	23.	21.	12.
AGE/YEAR	1974	1975	1976	1977	1978	1979	1980	
2	5811.	25008.	6382.	5526.	6835.	20912.	6363.	
3	16545.	4757.	20474.	5224.	4524.	5595.	17120.	
4	17393.	13535.	3809.	16706.	4275.	3695.	4552.	
5	9935.	14113.	10916.	3073.	13622.	3473.	2916.	
6	5987.	8034.	10480.	8830.	2409.	10785.	2561.	
7	1925.	4850.	6261.	8274.	6960.	1704.	6484.	
8	1584.	1470.	3896.	4708.	6117.	4777.	847.	
9	3610.	1244.	1102.	3095.	3517.	3553.	2635.	
10	9318.	2779.	955.	760.	2347.	2444.	1163.	
11	17954.	7443.	2222.	737.	537.	1652.	1515.	
12	3148.	14341.	5949.	1713.	520.	378.	1023.	
13	6630.	2515.	11463.	4586.	1209.	366.	234.	
14	38841.	5296.	2011.	8836.	3234.	851.	226.	
15	44091.	31658.	4233.	1550.	6233.	2276.	527.	
16	47295.	35950.	25809.	3263.	1094.	4387.	1409.	
17	34473.	38362.	29317.	20913.	2301.	770.	2717.	
18	26730.	28026.	31127.	23775.	16726.	1620.	476.	
19	10335.	21747.	22791.	24933.	19049.	13411.	1003.	
20	45.	8047.	17697.	18355.	19405.	15298.	10634.	

HERRING AREA KLMN AS
CATCH PROJECTION FOR 1981

AGE	POPULATION NUMBERS	POPULATION WEIGHT	FISHING MORTALITY	CATCH NUMBERS	CATCH WEIGHT	RESIDUAL NUMBERS	RESIDUAL WEIGHT
2	5000.	250.	.004	17.	1.	4078.	204.
3	5192.	587.	.019	89.	10.	4171.	471.
4	13788.	2427.	.038	467.	82.	10866.	1912.
5	3606.	801.	.076	240.	53.	2736.	607.
6	2235.	572.	.191	352.	90.	1513.	387.
7	1778.	523.	.381	514.	151.	994.	292.
8	3817.	1229.	.381	1103.	355.	2135.	687.
9	499.	170.	.381	144.	49.	279.	95.
10	1551.	546.	.381	448.	158.	868.	305.
11	685.	288.	.381	198.	83.	383.	161.
12	892.	375.	.381	258.	108.	499.	210.
13	602.	253.	.381	174.	73.	337.	142.
14	138.	58.	.381	40.	17.	77.	32.
15	133.	56.	.381	39.	16.	75.	31.
16	310.	131.	.381	90.	38.	174.	73.
17	830.	349.	.381	240.	101.	464.	195.
18	1599.	673.	.381	462.	195.	895.	377.
19	280.	118.	.381	81.	34.	157.	66.
20	6850.	2884.	.381	1979.	833.	3831.	1613.
TOTAL	49784.	12289.		6935.	2448.	34530.	7863.

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	17.	1.	4078.	204.
3	4078.	461.	.019	70.	8.	3276.	370.
4	4171.	734.	.038	141.	25.	3287.	579.
5	10866.	2412.	.076	724.	161.	8244.	1830.
6	2736.	700.	.191	431.	110.	1851.	474.
7	1513.	445.	.381	437.	129.	846.	249.
8	994.	320.	.381	287.	93.	556.	179.
9	2135.	726.	.381	617.	210.	1194.	406.
10	279.	98.	.381	81.	28.	156.	55.
11	868.	365.	.381	251.	106.	485.	204.
12	383.	161.	.381	111.	47.	214.	90.
13	499.	210.	.381	144.	61.	279.	117.
14	337.	142.	.381	97.	41.	188.	79.
15	77.	32.	.381	22.	9.	43.	18.
16	75.	31.	.381	22.	9.	42.	18.
17	174.	73.	.381	50.	21.	97.	41.
18	464.	195.	.381	134.	56.	260.	109.
19	895.	377.	.381	259.	109.	500.	211.
20	3988.	1679.	.381	1152.	485.	2231.	939.
TOTAL	39530.	9413.		5047.	1708.	27828.	6172.