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## AN ASSESSMENT OF THE 4T HERRING STOCK

by

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### Abstract

Reported landings of herring in NAFO Division 4T declined from a maximum of 175,000 tonnes in 1970 to a minimum of 21,000 tonnes in 1981, to increase to 26,000 tonnes in 1983. The average catch per net per trip reached a low point of 132 kg. in fall gillnet fisheries in 1980, but increased to 314 kg. in 1983, a value similar to the 1973-1982 fall fishery average. The average catch per net per trip in spring gillnet fisheries reached a low of 27 kg. in 1981 and increased to 54 kg. in 1983, a value similar to the 1973-1982 spring fishery average. These gillnet catch rates were used to fine tune sequential population analyses of the spring and fall spawners separately. The 1979 year class furnished cost of the spring spawner catch in 1982 and 1983 (77% and 63% respectively). 1983 fall spawner catches were also dominated by the 1979 year class (40%), but over half of the catch was composed of fish aged 5 or older. Partial recruitment was estimated to correspond to a dome-shaped curve, with maximum exploitation rates at age 5 for spring spawners ( $F_t = 0.45$ ) and at age 6 for fall spawners ( $F_t = 0.35$ ). Although the 1983 4+ biomass of fall spawners was higher than in any year since 1977, it was substantially lower than previous levels. The 1983 4+ biomass of spring spawners was similar to the 1979 level, but much lower than in most earlier years. The  $F_{0.1}$  catch of fall spawners in 1985 is predicted to be 12,691 tonnes, and the  $F_{0.1}$  catch of spring spawners is predicted to be 7,496 tonnes.

### Résumé

Les débarquements de hareng rapportés dans la Division 4T de l'OPANO sont passés d'un maximum de 175,000 tonnes en 1970, à un minimum de 21,000 tonnes en 1981, pour finalement augmenter à 26,000 tonnes en 1983. La prise moyenne par filet par voyage des pêcheries d'automne aux filets maillants a atteint un seuil inférieur de 132 kg. en 1980, mais cette moyenne a augmenté à 314 kg. en 1983, soit une valeur comparable à la moyenne de 1973 à 1982 pour les pêcheries d'automne. La prise moyenne par filet par voyage des pêcheries du printemps aux filets maillants a atteint une valeur semblable à la moyenne de 1973 à 1982 pour ces pêcheries. Ces taux de capture des filets ont été utilisés pour ajuster les analyses séquentielles de populations pour les reproducteurs du printemps et de l'automne séparément. La classe d'âge de l'année 1979 a fourni la plus grande part des captures de reproducteurs d'automne en 1982 et en 1983 (soit 77% et 63% respectivement). En 1983, les captures d'automne ont été dominées également par la classe d'âge de 1979 (40%), mais plus de la moitié des captures étaient constituée de poissons âgés de cinq ans et plus. L'estimation du recrutement partiel a donné une courbe en dôme, avec des taux d'exploitation maximum à l'âge cinq pour les reproducteurs du printemps ( $F_t = 0.45$ ) et à l'âge six pour les reproducteurs d'automne ( $F_t = 0.35$ ). Bien que la biomasse des reproducteurs d'automne âgés de quatre ans et plus a été supérieure à celle des autres années depuis 1977, elle était bien inférieure à celle des années avant 1977. En 1983, la biomasse des reproducteurs du printemps âgés de quatre ans et plus a été semblable au niveau de 1979, mais bien inférieure aux niveaux de la plupart des années avant 1979. Les captures de reproducteurs d'automne en 1985 à  $F_{0.1}$  seront de 12,691 tonnes, et les captures de reproducteurs du printemps à  $F_{0.1}$  seront de 7,496 tonnes.

### Landings

Prior to 1965, the southern Gulf of St. Lawrence (NAFO Division 4T, Figure 1) herring stock complex was exploited primarily by gillnets. Traps were used on the Magdalen Islands. Most fishing was conducted on spawning grounds in May, August, and September. Total annual landings averaged 32,925 tonnes between 1949 and 1964, varying from 18,819 to 42,940 tonnes. Subsequently, a purse seine fishery developed, which concentrated on feeding, migrating, and overwintering herring schools. By 1968, landings occurred in every month of the year. The winter fishery was concentrated along the shore of southwestern Newfoundland (NAFO Subdivision 3Pn) where landings reached a maximum in excess of 95,000 tonnes in 1969, only to decline and disappear by 1973. 4T landings attained a maximum in excess of 175,000 tonnes in 1970 (Table 1), but declined rapidly as a result of reduced abundance of herring.

A Total Allowable Catch (TAC) of 55,000 tonnes was first set in 1975. It was reduced to 16,000 tonnes in 1981, 15,000 tonnes in 1982, and 20,000 tonnes in 1983. Nominal catches were considerably greater than these recent regulations (Table 1). However, catch statistics are unreliable as an indicator of total removals. Most catches of herring for bait are not reported; unsaleable fish are often discarded; and underreporting is known to occur.

Tagging studies have shown that some portion of the 4T herring populations overwinters in the Sydney Bight (NAFO Subdivision 4Vn), where a winter purse seine fishery occurs (Simon and Stobo, MS 1983). It is not possible to estimate accurately the quantity of 4T herring caught in that fishery.

1983 landings in the southern Gulf exceeded those of 1982. The greatest increase occurred in the August gillnet fishery (Tables 1, 2 and 3).

### Catch Sampling

Catch sampling and analysis were conducted by personnel from the Moncton and Quebec City laboratories. The number of fish sampled is shown in Table 4.

### Abundance Indices

Because of the schooling behavior of herring, catch rates are not expected to be directly proportional to stock abundance. In particular, there is evidence that purse seine catch rates are unreliable indicators of stock size (see for example: Powles, MS 1981 and Ulltang, 1976).

However, long term trends in gillnet catch rates are assumed to reflect major trends in spawner biomass. Consequently, catch rate indices for the gillnet fisheries were used to detect biomass trends.

### Gillnet Indices

Accurate or precise measures of gillnet effort are not available. The catch per successful trip has fluctuated considerably during the eleven years for which data are available (Table 5)(Messieh, MS 1984).

In the case of spring fisheries, the 1982 and 1983 rates in the second most important fishery (Caraquet) were double the 1981 rate, but less than most previous levels. However, the 1983 rate in the largest spring fishery (Escuminac) was substantially higher than the long term average and three times as high as the 1981 rate.

The catch rate in the most important fall gillnet fishery (Caraquet) increased substantially after 1980. But the 1983 level was still lower than mid-1970's levels. Landings in Pictou County were unstable throughout the period, with marked variations in effort. The 1983 catch per successful trip was higher than every other year but one.

Cleary (MS 1983) used the results of questionnaire surveys to estimate the numbers of nets per trip in each year since 1973. She used these estimates to calculate the catch per net per successful trip in the major gillnet fisheries. Recent questionnaires have indicated that there was no apparent change in the number of nets per trip from 1982 to 1983. Consequently, indices of catch per net per successful trip were calculated for the entire spring and fall gillnet fisheries separately (Table 6). The 1983 catch rates in both seasons were similar to the averages for the previous 10 years. Catch rates were better in 1982 and 1983 than in 1980 and 1981.

The calculated results discussed above are consistent with comments made by gillnet fishermen in meetings and questionnaires. Most comments on the observed abundance of spawning reflected a similarity between 1982 and 1983. Some fall fishermen, notably in the Chaleur Bay area, indicated an increase in spawning activity. A few fishermen in Nova Scotia noted some decrease outside major fishing areas.

### Purse Seine Catch Rates

The overall fall catch per set in 1983 was 34% higher than the 1981 rate, and was equal to the 10 year average (1972 to 1981) (Table 7). Observers on seiners noted that considerable releasing of small herring occurred in response to market restrictions and government regulations. If these fish had been retained (as they would have been during the mid 1970's), the 1983 catch rate would have been higher.

### Age Composition

Observed weights at age from the commercial fisheries are presented in Tables 8 and 9. From 1971 to 1980 these data were obtained from the spring purse seine fishery. In 1981 and 1982, data came from the spring gillnet

fishery, since the spring purse seine fishery no longer occurred. In 1983, spring spawner data came from the spring gillnet fishery. Fall spawner data were from the August gillnet fishery, since May data were insufficient to establish weights at age for fall spawners.

1983 Catches at age of spring and fall spawners separately in each major fishery are presented in Table 10 (see Figure 1 for locations of unit areas). Annual catches at age from each spawning group for the period from 1971 to 1983 are in Tables 11 and 12.

The 1979 year class furnished most of the spring spawner catch in 1982 and 1983 (77% and 63% respectively). The spring spawner catches contained higher percentages of fish aged four or younger in 1982 and 1983 than in any other recent year.

The 1977 year class, which dominated fall spawner catches in 1981 and 1982, was still quite strong in 1983. However, the 1979 year class provided 40% of the fall spawner catch in 1983. Over half of the 1982 and 1983 fall spawner catches were composed of fish aged five or older.

Partial Recruitment

Fall Spawners: For fall spawners, partial recruitment rates for ages three and older were estimated from the weighted averages of the selectivity ogives of the major gears in the fall fisheries. The partial recruitment rate at age two was selected to give a 1983 population estimate at age two equal to the geometric mean for 1971 to 1980. The results were as follow:

Age:	2	3	4	5	6	7	8	9	10	11+
P.R.:	.003	.23	.72	.96	1.0	.90	.79	.66	.60	.60

Spring Spawners: For spring spawners, partial recruitment rates for ages four and older were estimated, as for fall spawners, from the weighted averages of the selectivity ogives of the major gears exploiting spring spawners. The age three population estimate was obtained by regressing the estimated population abundance at age three against gillnet catch rates of 3 year olds for the period 1975 to 1982 and predicting abundance from the 1983 catch rate (Figure 2). The partial recruitment rate at age three was thus implicitly established. The rate at age two was selected to give a 1983 population estimate at age two equal to the geometric mean for 1971 to 1980. The results were as follows:

Age:	2	3	4	5	6	7	8	9	10	11+
P.R.:	.025	.80	.87	1.0	.95	.72	.50	.36	.21	.16

### Sequential Population Analyses

Fall Spawners: Sequential population analyses were run with a range of terminal  $F_t$ 's. The 4+ population biomass (an estimate of spawning biomass) was correlated with fall gillnet catch rates for the period 1975 to 1983. The criteria used to select  $F_t$  were the maximization of the correlation coefficient ( $r$ ) and the minimization of the residuals of the 1981 to 1983 4+ biomass. This led to the choice of  $F_t = 0.35$  (Table 13 and Figure 3).

The SPA showed that the 1977 year class was the strongest since 1970 and that the 1979 year class was the second strongest (Tables 14 and 15). The 4+ biomass was higher in 1983 than in any year since 1977, but substantially lower than previous levels (Table 16).

Spring Spawners: Because catches of spring spawners were again in 1983 dominated by one year class, the size of this year class (1979) in 1983 was estimated as a means of obtaining  $F_t$ . The age four population abundance from SPA runs was regressed on gillnet catch rates at age four for the period 1974 to 1982. The criteria used to select  $F_t$  were the maximization of the correlation coefficient and the minimization of the residual of the 1983 four year old population abundance. These led to the choice of  $F_t = 0.45$  (Table 17 and Figure 4).

The SPA showed that the 1979 year class was the strongest since 1974 (Tables 18 and 19). However, 86% of the 1983 4+ biomass was represented by this one year class (Table 20). Total 4+ biomass was similar to the 1979 level, but much lower than in most earlier years.

### Catch Projections

Projections of spring and fall spawner catches and biomasses for 1985 and 1986 were made using estimates of 1984 catches based upon the established TAC and assuming fishing at  $F_{0.1} = 0.30$  in the future. Recruitment at age two was set equal to the geometric mean for the period 1971 to 1980. Weights at age and partial recruitment identical to 1983 were assumed. Projection results are presented in Tables 21 to 28.

The  $F_{0.1}$  catch of fall spawners in 1985 is predicted to be 12,691 tonnes. The projected 1985 starting biomass of fall herring aged four years and older (an estimate of the spawning stock) is lower than every year known except for 1979 to 1982 (Figure 5).

The  $F_{0.1}$  catch of spring spawners in 1985 is predicted to be 7,496 tones. The projected 1985 starting biomass of spring herring aged four years and older (an estimate of the spawning stock) is lower than every year known except 1980 to 1982 (Figure 5).

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**Table 1: Herring landings\* in NAFO division 4T, 1967 to 1983**

Year	January	Feb.	March	April	May	June	July	August	Sept.	October	Nov.	Dec.	Total
1967	1742	-	-	409	25220	8764	5679	10718	4620	1358	3095	1131	62736
1968	546	442	806	6455	24239	2566	15847	19768	22350	5284	13057	770	112130
1969	-	-	73	9329	17701	6568	35476	46987	22448	4169	11543	121	154415
1970	-	55	-	21211	15782	2545	51002	36860	24959	18506	3831	746	175497
1971	-	-	42	10644	11895	4809	41521	23067	36282	5163	1053	370	134846
1972	-	-	-	400	6102	2583	11034	9092	14453	7777	2108	41	53590
1973	-	-	-	1876	12801	4221	2135	7737	9436	2079	69	3	40357
1974	-	-	-	1302	14474	1190	2958	3143	7282	3081	1714	9	35153
1975	-	-	-	4028	20229	1428	289	2398	4646	8986	2256	305	44565
1976	-	-	-	8461	14406	961	193	1082	1807	5244	6973	326	39453
1977	-	-	-	7625	8338	8850	244	2125	1148	7166	8726	602	44824
1978	240	-	-	2046	13363	883	526	2487	10095	13672	6981	2848	53141
1979	-	-	-	14072	6158	1113	680	1766	6381	5071	9904	2598	47743
1980	80	-	15	10458	9220	1032	910	2224	1952	9011	5001	540	40443
1981	-	-	13	1736	4566	729	1588	5119	3986	2171	1246	-	21154
1982**	-	-	-	199	5667	876	442	5592	8047	3122	36	-	23981
1983**	-	-	-	263	7282	1000	851	10291	2735	2160	1291	-	25873

\* 1967 to 1981 from Cleary (1983)

\*\* Provisional



**Table 2: Catches (t) of herring by gear and by season in NAFO Division 4T, 1971-1983**

YEAR	GILLNETS (and other inshore)		SEINES (and other offshore)		TOTAL
	SPRING	FALL	SPRING	FALL	
1971	14074	10327	13316	97129	134846
1972	8137	9585	948	34910	53580
1973	11713	7920	7185	13539	40357
1974	8285	4199	8681	13988	35153
1975	7119	4741	18566	14139	44565
1976	6611	3419	17217	12206	39453
1977	4926	3285	19887	16726	44824
1978	8484	4853	8048	31756	53141
1979	7444	5780	13899	20620	47743
1980	6443	6784	13330	13886	40443
1981	6545	10926	20	4552	22043
1982*	6742	14130	0	3109	23981
1983*	8545	13858	0	3470	25873

\* preliminary

**Table 3: Preliminary herring landings (t) in NAFO Division 4T in 1983**

	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Total
<b>MARITIMES</b>									
GND 1	14	564	57	71	2068	393	-	-	3,167
GNS 1	64	6120	916	761	7060	2197	7	-	17,125
PS 3,4	-	-	-	-	-	29	2150	1291	3,470
MISC.	4	67	27	19	102	116	4	-	339
									=====
									24,101
<b>QUEBEC</b>									
GND.	240	352	74	321	543	188	-	-	1,718
MISC.	13	29	3	1	-	2	6	-	54
									=====
									1,772
									=====
									25,873

GND - Drift gillnets

GNS - Set gillnets

**Table 4: 1983 Sampling Summary (Numbers of fish)**

AREA	GILLNET				PURSE SEINE	
	SPRING		FALL		Det	LF
	Det	LF	Det	LF		
436	659		174	1421		
4T (except 436)	160					
432 / 433 / 434			895	5789		
437 / 438			1103	2373	1069	3402

NOTES:

Det: detailed sampling for age, maturity, gonad weight, etc.

LF: length-frequency only.

When both "Det" and "LF" are indicated, the former is included in the latter.

**Table 5: Catch (t) per successful trip for gillnet herring fisheries in NAFO Division 4T, 1973-1983 (Messieh, 1984).**

<b>YEAR</b>	<b>SPRING FISHERY (Jan - June)</b>	<b>FALL FISHERY (July - Dec.)</b>
1973	2.09	2.66
1974	1.23	2.99
1975	1.29	3.63
1976	1.34	3.13
1977	1.89	3.56
1978	2.22	3.21
1979	1.49	1.78
1980	1.09	1.45
1981	0.92	2.15
1982	1.73	2.33
1983	1.79	3.45

Table 6: Catch (t) per net per trip for gillnet herring fisheries in NAFO Division 4T, 1973 - 1983.

YEAR	SPRING FISHERY (Jan - June)	FALL FISHERY (July - Dec)
1973	.079	.375
1974	.050	.393
1975	.044	.504
1976	.045	.352
1977	.066	.383
1978	.072	.282
1979	.040	.156
1980	.034	.132
1981	.027	.196
1982	.052	.212
1983	.054	.314

**Table 7: Catch (t) per set in the fall purse seine herring fishery in NAFO Division 4T, 1969 - 1983**

<b>YEAR</b>	<b>FALL FISHERY</b>
1969	110.2
1970	90.9
1971	56.7
1972	45.1
1973	41.5
1974	37.9
1975	34.5
1976	40.6
1977	44.4
1978	44.3
1979	24.5
1980	18.7
1981	26.6
1982	
1983	35.5

Table 8:

## 4T Herring Fall Spawners :Wts at age (kilogrammes)

YEAR :	71	72	73	74	75	76	77	78	79	80	81	82	83
AGE :													
2 :	0.040	0.040	0.040	0.047	0.040	0.035	0.040	0.040	0.037	0.076	0.076	0.094	0.112
3 :	0.093	0.053	0.100	0.126	0.115	0.111	0.099	0.128	0.083	0.109	0.143	0.151	0.169
4 :	0.142	0.168	0.170	0.190	0.169	0.184	0.166	0.191	0.168	0.172	0.242	0.155	0.246
5 :	0.189	0.194	0.206	0.235	0.215	0.217	0.202	0.231	0.217	0.224	0.273	0.189	0.284
6 :	0.129	0.238	0.242	0.255	0.248	0.253	0.229	0.260	0.262	0.257	0.317	0.237	0.319
7 :	0.234	0.253	0.269	0.283	0.272	0.276	0.260	0.288	0.288	0.300	0.326	0.324	0.356
8 :	0.248	0.262	0.292	0.314	0.288	0.283	0.276	0.315	0.312	0.329	0.348	0.237	0.357
9 :	0.264	0.277	0.295	0.327	0.314	0.300	0.287	0.313	0.329	0.346	0.394	0.285	0.359
10 :	0.272	0.287	0.313	0.331	0.325	0.323	0.285	0.322	0.333	0.375	0.328	0.380	0.389
11 :	0.297	0.312	0.342	0.354	0.362	0.349	0.324	0.363	0.380	0.386	0.427	0.389	0.393
12 :	0.390	0.390	0.390	0.390	0.390	0.390	0.390	0.390	0.390	0.390	0.390	0.390	0.390
13 :	0.390	0.390	0.390	0.390	0.390	0.390	0.390	0.390	0.390	0.390	0.390	0.390	0.390
14 :	0.390	0.390	0.390	0.390	0.390	0.390	0.390	0.390	0.390	0.390	0.390	0.390	0.390
15 :	0.390	0.390	0.390	0.390	0.390	0.390	0.390	0.390	0.390	0.390	0.390	0.390	0.390
16 :	0.400	0.400	0.400	0.400	0.400	0.400	0.400	0.400	0.400	0.400	0.400	0.400	0.400
17 :	0.400	0.400	0.400	0.400	0.400	0.400	0.400	0.400	0.400	0.400	0.400	0.400	0.400
18 :	0.400	0.400	0.400	0.400	0.400	0.400	0.400	0.400	0.400	0.400	0.400	0.400	0.400
19 :	0.400	0.400	0.400	0.400	0.400	0.400	0.400	0.400	0.400	0.400	0.400	0.400	0.400
20 :	0.400	0.400	0.400	0.400	0.400	0.400	0.400	0.400	0.400	0.400	0.400	0.400	0.400
MEAN :	0.288	0.297	0.307	0.317	0.311	0.310	0.301	0.316	0.314	0.323	0.339	0.316	0.344
MEAN/POP:	0.235	0.205	0.217	0.249	0.232	0.197	0.159	0.185	0.116	0.132	0.166	0.159	0.215

Table 9:

4T Herring Spring Spawners :Wts at age (kilogrammes)

YEAR :	71	72	73	74	75	76	77	78	79	80	81	82	83
AGE :													
2 :	0.075	0.075	0.087	0.095	0.090	0.104	0.092	0.094	0.062	0.093	0.124	0.117	0.142
3 :	0.103	0.140	0.141	0.160	0.154	0.177	0.157	0.150	0.138	0.140	0.173	0.170	0.170
4 :	0.185	0.207	0.184	0.202	0.185	0.210	0.185	0.202	0.181	0.180	0.232	0.202	0.221
5 :	0.221	0.233	0.219	0.238	0.229	0.247	0.236	0.243	0.234	0.220	0.277	0.247	0.243
6 :	0.243	0.274	0.267	0.275	0.266	0.275	0.265	0.293	0.262	0.250	0.318	0.295	0.260
7 :	0.268	0.311	0.282	0.291	0.298	0.271	0.272	0.305	0.288	0.303	0.346	0.285	0.322
8 :	0.292	0.318	0.310	0.319	0.304	0.304	0.279	0.323	0.328	0.328	0.366	0.299	0.340
9 :	0.290	0.339	0.327	0.320	0.316	0.310	0.296	0.341	0.341	0.341	0.376	0.305	0.360
10 :	0.301	0.323	0.332	0.328	0.329	0.333	0.309	0.343	0.345	0.356	0.367	0.312	0.375
11 :	0.319	0.344	0.374	0.348	0.357	0.353	0.332	0.373	0.373	0.415	0.413	0.420	0.385
12 :	0.390	0.390	0.390	0.390	0.390	0.390	0.390	0.390	0.390	0.390	0.390	0.390	0.390
13 :	0.390	0.390	0.390	0.390	0.390	0.390	0.390	0.390	0.390	0.390	0.390	0.390	0.390
14 :	0.390	0.390	0.390	0.390	0.390	0.390	0.390	0.390	0.390	0.390	0.390	0.390	0.390
15 :	0.390	0.390	0.390	0.390	0.390	0.390	0.390	0.390	0.390	0.390	0.390	0.390	0.390
16 :	0.400	0.400	0.400	0.400	0.400	0.400	0.400	0.400	0.400	0.400	0.400	0.400	0.400
17 :	0.400	0.400	0.400	0.400	0.400	0.400	0.400	0.400	0.400	0.400	0.400	0.400	0.400
18 :	0.400	0.400	0.400	0.400	0.400	0.400	0.400	0.400	0.400	0.400	0.400	0.400	0.400
19 :	0.400	0.400	0.400	0.400	0.400	0.400	0.400	0.400	0.400	0.400	0.400	0.400	0.400
20 :	0.400	0.400	0.400	0.400	0.400	0.400	0.400	0.400	0.400	0.400	0.400	0.400	0.400
MEAN :	0.308	0.322	0.320	0.323	0.320	0.323	0.315	0.328	0.322	0.326	0.345	0.327	0.336
MEAN/POP:	0.192	0.240	0.228	0.216	0.223	0.169	0.182	0.199	0.156	0.154	0.147	0.163	0.188



Table 10: Catches at age (thousands) of herring by fishery and by spawning group in NAFO Division 4T in 1983

**SPRING SPAWNERS**

**AGES**

FISHERY	2	3	4	5	6	7	8	9	10	11	TOTAL
436 fall gillnets	0	154	61	31							246
437/8 fall gillnets	18	48	156	40							262
432/3/4 fall g.n.	0										0
436 spring gillnets	0	4901	15124	1015	280	35					21356
other spr. gillnets	0	1332	13099	2109	555						17095
437/8 fall seines	780	5818	2048	276	81	33	49	16			9101
<b>TOTAL</b>	<b>798</b>	<b>12253</b>	<b>30487</b>	<b>3471</b>	<b>916</b>	<b>68</b>	<b>49</b>	<b>16</b>			<b>48059</b>

**FALL SPAWNERS**

**AGES**

FISHERY	2	3	4	5	6	7	8	9	10	11	TOTAL
436 fall gillnets	0	246	2764	860	983	215	30				5097
437/8 fall gillnets	0	238	10668	4250	9098	948	403	95	24	142	25865
432/3/4 fall g.n.	0	239	6415	4963	2059	846	1305	460	55	110	16452
436 spring gillnets	0	70	1085	280	280						1716
other spr. gillnets	0	0	333	222	0	111					666
437/8 fall seines	114	4030	2161	488	1073	179	98	49	33	49	8272
<b>TOTAL</b>	<b>114</b>	<b>4823</b>	<b>23427</b>	<b>11062</b>	<b>13492</b>	<b>2298</b>	<b>1836</b>	<b>603</b>	<b>111</b>	<b>301</b>	<b>58068</b>

Table 11:

## 4T Herring Fall Spawners :Catch at age (1000's)

YEAR :	71	72	73	74	75	76	77	78	79	80	81	82	83
AGE :													
2 :	4900.	5700.	1700.	4700.	100.	100.	200.	1500.	2900.	1300.	100.	200.	114.
3 :	33100.	5200.	3300.	5000.	2200.	300.	3000.	19200.	6200.	30600.	9300.	9400.	4823.
4 :	92800.	15600.	4500.	16200.	4100.	1900.	7900.	27600.	34600.	9400.	30600.	19700.	23427.
5 :	35300.	51100.	7900.	5700.	25500.	5400.	3600.	14300.	27400.	22000.	5500.	23800.	11062.
6 :	59800.	20800.	19800.	3800.	7000.	31200.	3600.	4000.	11000.	7900.	2400.	5100.	13492.
7 :	87600.	28500.	9000.	9700.	3300.	4500.	22400.	3500.	2300.	3900.	900.	2100.	2298.
8 :	114300.	26200.	11800.	2500.	5000.	2000.	2200.	14100.	3100.	600.	900.	900.	1836.
9 :	57800.	23400.	7400.	5200.	2200.	3800.	1400.	1600.	5200.	800.	200.	600.	603.
10 :	30900.	11500.	9500.	3900.	3700.	800.	2800.	900.	700.	300.	100.	200.	111.
11 :	35200.	9000.	2000.	6900.	3900.	2600.	700.	2100.	700.	200.	100.	1.	301.
12 :	40600.	10300.	1600.	1500.	6800.	2800.	2300.	500.	1500.	200.	100.	1.	1.
13 :	145600.	11800.	1800.	1200.	1500.	4900.	2500.	1700.	400.	400.	100.	1.	1.
14 :	1.	42400.	2100.	1300.	1200.	1100.	4400.	1900.	1300.	100.	100.	1.	1.
15 :	1.	1.	7400.	1500.	1300.	900.	1000.	3300.	1400.	300.	1.	1.	1.
16 :	1.	1.	1.	5300.	1500.	900.	800.	800.	2400.	400.	100.	1.	1.
17 :	1.	1.	1.	1.	5200.	1100.	800.	600.	600.	600.	100.	1.	1.
18 :	1.	1.	1.	1.	1.	3600.	1000.	600.	400.	200.	200.	1.	1.
19 :	1.	1.	1.	1.	1.	1.	3100.	800.	400.	100.	1.	1.	1.
20 :	1.	1.	1.	1.	1.	1.	1.	4000.	1200.	300.	1.	1.	1.
2+ :	737907.	261506.	89805.	74404.	74503.	67902.	63701.	103000.	103700.	79600.	50803.	62010.	58076.
3+ :	733007.	255806.	88105.	69704.	74403.	67802.	63501.	101500.	100800.	78300.	50703.	61810.	57962.
4+ :	699907.	250606.	84805.	64704.	72203.	67502.	60501.	82300.	94600.	47700.	41403.	52410.	53139.
5+ :	607107.	235006.	80305.	48504.	68103.	65602.	52601.	54700.	60000.	38300.	10803.	32710.	29712.

Table 12:

## 4T Herring Spring Spawners :Catch at age (1000's)

YEAR :	71	72	73	74	75	76	77	78	79	80	81	82	83
AGE :													
2 :	3200.	100.	1600.	4600.	1600.	17300.	3300.	14300.	21700.	20300.	5700.	1000.	798.
3 :	65700.	2100.	1700.	8700.	26800.	9100.	60300.	14700.	13300.	39800.	16400.	29600.	12253.
4 :	6800.	27500.	2500.	3300.	19200.	29300.	7400.	67700.	5700.	5300.	7600.	5500.	30487.
5 :	13600.	5800.	31700.	1700.	3200.	7200.	10800.	4800.	32900.	2900.	1200.	1300.	3471.
6 :	9300.	5000.	6100.	21900.	16800.	2400.	3600.	7100.	2100.	14700.	800.	300.	916.
7 :	8800.	3300.	3900.	3800.	20100.	500.	600.	1300.	3000.	3100.	4100.	200.	68.
8 :	14300.	3900.	6000.	4100.	2500.	9400.	500.	1200.	700.	1900.	700.	300.	49.
9 :	15000.	4500.	2300.	6000.	3300.	1100.	6600.	200.	200.	700.	700.	100.	16.
10 :	5000.	4900.	2300.	900.	5300.	1600.	500.	3700.	700.	300.	100.	1.	1.
11 :	16500.	300.	2700.	700.	1700.	9900.	900.	100.	2200.	500.	100.	1.	1.
12 :	45700.	900.	200.	900.	1400.	3200.	5800.	100.	100.	1400.	200.	1.	1.
13 :	5300.	2500.	500.	100.	1700.	2600.	1900.	900.	100.	100.	500.	1.	1.
14 :	1.	300.	1300.	200.	200.	3100.	1500.	300.	500.	100.	1.	1.	1.
15 :	1.	1.	200.	300.	400.	400.	1800.	200.	200.	300.	1.	1.	1.
16 :	1.	1.	1.	100.	600.	700.	200.	300.	100.	100.	100.	1.	1.
17 :	1.	1.	1.	1.	200.	1100.	400.	1.	100.	100.	100.	1.	1.
18 :	1.	1.	1.	1.	1.	400.	700.	100.	1.	100.	100.	1.	1.
19 :	1.	1.	1.	1.	1.	1.	300.	100.	1.	1.	1.	1.	1.
20 :	1.	1.	1.	1.	1.	1.	1.	1.	100.	1.	1.	1.	1.
2+ :	209207.	61106.	63005.	57304.	105003.	99302.	107101.	117102.	83702.	91702.	38404.	38311.	48069.
3+ :	206007.	61006.	61405.	52704.	103403.	82002.	103801.	102802.	62002.	71402.	32704.	37311.	47271.
4+ :	140307.	58906.	59705.	44004.	76603.	72902.	43501.	88102.	48702.	31602.	16304.	7711.	35018.
5+ :	133507.	31406.	57205.	40704.	57403.	43602.	36101.	20402.	43002.	26302.	8704.	2211.	4531.

Table 13: Parameters of regressions between fall 4+ biomass and gillnet catch rates at various  $F_t$  levels.

$F_t$	Correlation Coefficient (r)	Cumulative Residuals (1981 - 1983)
.25	.91	2.01
.30		3.72
.35	.93	1.55
.40		4.58
.45	.92	

Table 14:

4T Herring Fall Spawners :Population (1000's)

YEAR :	71	72	73	74	75	76	77	78	79	80	81	82	83
AGE :													
2 :	82672.	306479.	60508.	49836.	89318.	141762.	166051.	74219.	253554.	123679.	185153.	84141.	115987.
3 :	106767.	63265.	245777.	48005.	36565.	73037.	115972.	135770.	59411.	204973.	100086.	151494.	68708.
4 :	276280.	57718.	47107.	198245.	34796.	27951.	59526.	92241.	93864.	43052.	140258.	73557.	115552.
5 :	101467.	143004.	33246.	34510.	147698.	24793.	21171.	41618.	50753.	45860.	26795.	87317.	42530.
6 :	175854.	51439.	71299.	20119.	23123.	97971.	15443.	14092.	21257.	17157.	17914.	16991.	50116.
7 :	197022.	90373.	23505.	40596.	13052.	12650.	52227.	9408.	7947.	7601.	6992.	12505.	9334.
8 :	265960.	83038.	48426.	11187.	24519.	7721.	6325.	22735.	4568.	4442.	2747.	4914.	8347.
9 :	103153.	115572.	44484.	29044.	6911.	15577.	4525.	3207.	6105.	998.	3096.	1442.	3213.
10 :	64779.	33036.	73573.	29758.	19099.	3685.	9338.	2449.	1199.	467.	116.	2354.	644.
11 :	75932.	25458.	16742.	51676.	20850.	12308.	2298.	5133.	1199.	359.	116.	8.	1747.
12 :	96049.	30737.	12779.	11905.	36093.	13561.	7738.	1253.	2324.	359.	116.	8.	6.
13 :	333442.	42336.	15932.	9021.	8395.	23431.	8584.	4272.	579.	574.	116.	8.	6.
14 :	24.	142871.	24067.	11421.	6304.	5523.	14777.	4784.	1976.	120.	116.	8.	6.
15 :	19.	19.	78921.	17810.	8179.	4082.	3532.	8149.	2217.	467.	11.	8.	6.
16 :	16.	14.	15.	57942.	13229.	5526.	2533.	1994.	3720.	574.	116.	8.	6.
17 :	14.	12.	11.	11.	42660.	9479.	3714.	1356.	917.	919.	116.	8.	6.
18 :	7.	10.	9.	8.	8.	30241.	6769.	2321.	574.	219.	221.	8.	6.
19 :	4.	5.	7.	6.	6.	6.	21515.	4642.	1362.	117.	7.	8.	6.
20 :	3.	3.	3.	5.	4.	4.	4.	14822.	3080.	756.	8.	5.	6.
2+ :	1879464.	1185390.	796410.	621107.	530809.	509308.	522043.	444467.	516603.	452693.	484104.	434794.	416232.
3+ :	1796792.	878911.	735901.	571270.	441491.	367546.	355992.	370248.	263050.	329015.	298951.	350653.	300245.
4+ :	1690025.	815646.	490125.	523265.	404927.	294509.	240020.	234478.	203639.	124042.	198865.	199159.	231537.
5+ :	1413745.	757928.	443018.	325020.	370131.	266558.	180494.	142236.	109775.	80990.	58607.	125602.	115985.

Table 15:

## 4T Herring Fall Spawners :Fishing Mortality

YEAR :	71	72	73	74	75	76	77	78	79	80	81	82	83
AGE :													
2 :	0.067	0.020	0.031	0.110	0.001	0.000	0.001	0.022	0.012	0.011	0.000	0.002	0.001
3 :	0.415	0.094	0.014	0.122	0.068	0.004	0.028	0.169	0.122	0.179	0.108	0.070	0.080
4 :	0.459	0.352	0.111	0.094	0.139	0.077	0.158	0.397	0.516	0.274	0.274	0.348	0.252
5 :	0.479	0.496	0.302	0.200	0.211	0.273	0.207	0.472	0.885	0.740	0.256	0.355	0.336
6 :	0.466	0.583	0.363	0.233	0.403	0.429	0.296	0.373	0.828	0.698	0.159	0.399	0.350
7 :	0.664	0.424	0.542	0.304	0.325	0.493	0.632	0.522	0.382	0.818	0.153	0.204	0.315
8 :	0.633	0.424	0.311	0.282	0.254	0.334	0.479	1.115	1.321	0.161	0.444	0.225	0.277
9 :	0.939	0.252	0.202	0.219	0.429	0.312	0.414	0.784	2.371	1.950	0.073	0.606	0.231
10 :	0.734	0.480	0.153	0.156	0.239	0.272	0.398	0.514	1.005	1.189	2.454	0.098	0.210
11 :	0.704	0.489	0.141	0.159	0.230	0.264	0.406	0.592	1.005	0.928	2.454	0.144	0.210
12 :	0.619	0.457	0.148	0.149	0.232	0.257	0.394	0.573	1.199	0.928	2.454	0.144	0.210
13 :	0.648	0.365	0.133	0.158	0.219	0.261	0.385	0.571	1.371	1.396	2.454	0.144	0.210
14 :	0.046	0.393	0.101	0.134	0.235	0.247	0.395	0.569	1.243	2.182	2.454	0.144	0.210
15 :	0.061	0.059	0.109	0.097	0.192	0.277	0.372	0.584	1.152	1.189	0.104	0.144	0.210
16 :	0.072	0.080	0.077	0.106	0.133	0.197	0.425	0.577	1.198	1.396	2.454	0.144	0.210
17 :	0.084	0.096	0.107	0.104	0.144	0.137	0.270	0.660	1.230	1.225	2.454	0.144	0.210
18 :	0.161	0.114	0.132	0.149	0.144	0.140	0.177	0.334	1.393	3.236	3.096	0.144	0.210
19 :	0.281	0.240	0.160	0.189	0.217	0.209	0.173	0.210	0.389	2.428	0.169	0.144	0.210
20 :	0.536	0.501	0.401	0.238	0.293	0.351	0.333	0.351	0.555	0.569	0.140	0.255	0.210
MEAN :	0.425	0.312	0.186	0.169	0.216	0.239	0.313	0.494	0.957	1.131	1.166	0.203	0.219
MEAN/POP:	0.574	0.295	0.141	0.143	0.173	0.173	0.163	0.322	0.319	0.245	0.133	0.182	0.176

Table 16:

## 4T Herring Fall Spawners :Population Biomass (tonnes)

YEAR :	71	72	73	74	75	76	77	78	79	80	81	82	83
AGE :													
2 :	3307.	12259.	2420.	2342.	3573.	4962.	6642.	2969.	9381.	9400.	14072.	7909.	12991.
3 :	9929.	3353.	24578.	6049.	4205.	8107.	11481.	17379.	4931.	22342.	14312.	22876.	11612.
4 :	39232.	9697.	8008.	37667.	5880.	5143.	9881.	17618.	15769.	7405.	33942.	11401.	28426.
5 :	19177.	27743.	6849.	8110.	31755.	5380.	4276.	9614.	11013.	10273.	7315.	16503.	12079.
6 :	22685.	12242.	17254.	5130.	5734.	24787.	3536.	3664.	5569.	4409.	5679.	4027.	15987.
7 :	46103.	22864.	6323.	11489.	3550.	3491.	13579.	2709.	2289.	2280.	2280.	4051.	3323.
8 :	65958.	21756.	14141.	3513.	7061.	2185.	1746.	7162.	1425.	1461.	956.	1165.	2980.
9 :	27232.	32013.	13123.	9497.	2170.	4673.	1299.	1004.	2009.	345.	1220.	411.	1154.
10 :	17620.	9481.	23028.	9850.	6207.	1190.	2661.	789.	399.	175.	38.	895.	251.
11 :	22552.	7943.	5726.	18293.	7548.	4295.	744.	1863.	456.	139.	50.	3.	687.
12 :	37459.	11988.	4984.	4643.	14076.	5289.	3018.	489.	906.	140.	45.	3.	2.
13 :	130042.	16511.	6213.	3518.	3274.	9138.	3348.	1666.	226.	224.	45.	3.	2.
14 :	10.	55720.	9386.	4454.	2459.	2154.	5763.	1866.	771.	47.	45.	3.	2.
15 :	7.	7.	30779.	6946.	3190.	1592.	1378.	3178.	865.	182.	4.	3.	2.
16 :	6.	6.	6.	23177.	5292.	2210.	1013.	798.	1488.	229.	47.	3.	2.
17 :	5.	5.	4.	4.	17064.	3792.	1486.	542.	367.	368.	47.	3.	2.
18 :	3.	4.	4.	3.	3.	12096.	2708.	929.	230.	88.	88.	3.	2.
19 :	2.	2.	3.	3.	2.	2.	8606.	1857.	545.	47.	3.	3.	2.
20 :	1.	1.	1.	2.	2.	1.	2.	5929.	1232.	302.	3.	2.	2.
2+ :	441332.	243596.	172830.	154690.	123046.	100489.	83167.	82023.	59870.	59856.	80192.	69269.	89508.
3+ :	438025.	231336.	170409.	152348.	119473.	95527.	76525.	79054.	50488.	50457.	66120.	61360.	76518.
4+ :	428095.	227983.	145832.	146299.	115268.	87420.	65044.	61675.	45557.	28115.	51808.	38484.	64906.
5+ :	388864.	218287.	137823.	108633.	109388.	82277.	55163.	44057.	29788.	20710.	17865.	27083.	36480.

Table 17: Parameters of regressions between spring 4 year old population abundance and gillnet catch rates of 4 year olds at various  $F_t$  levels.

$F_t$	Correlation Coefficient (r)	1983 Residual
0.30	0.97	4.07
0.40	0.97	0.91
0.45	0.97	-0.14
0.50	0.97	-0.98



Table 18:

## 4T Herring Spring Spawners :Population (1000's)

YEAR :	71	72	73	74	75	76	77	78	79	80	81	82	83
AGE :													
2 :	67259.	29483.	77919.	146375.	52861.	324148.	41643.	45729.	97755.	72262.	199920.	55396.	78689.
3 :	347577.	52179.	24048.	62350.	115689.	41834.	249778.	31118.	24612.	60523.	40937.	158534.	44451.
4 :	45806.	225452.	40825.	18156.	43211.	70626.	26068.	150308.	12355.	8309.	14313.	18842.	103160.
5 :	54074.	31379.	159803.	31169.	11895.	18223.	31619.	14699.	62583.	5026.	2105.	4950.	10490.
6 :	109407.	32053.	20471.	102316.	23985.	6865.	8476.	16207.	7730.	21930.	1537.	657.	2885.
7 :	45063.	81188.	21740.	11286.	64075.	4800.	3469.	3721.	6924.	4443.	4949.	545.	270.
8 :	46515.	28977.	63492.	14289.	5834.	34429.	3479.	2300.	1881.	2987.	900.	469.	267.
9 :	51650.	25253.	20211.	46573.	8018.	2541.	19747.	2398.	814.	913.	761.	122.	118.
10 :	8766.	28823.	16625.	14474.	32724.	3613.	1097.	10250.	1783.	487.	132.	20.	12.
11 :	25205.	2731.	19187.	11540.	11039.	22020.	1529.	452.	5078.	833.	132.	20.	16.
12 :	64217.	6024.	1965.	13277.	8816.	7507.	9185.	452.	280.	2191.	238.	20.	16.
13 :	9415.	12245.	4122.	1429.	10058.	5957.	3285.	2377.	280.	140.	553.	20.	16.
14 :	22.	2994.	7776.	2924.	1080.	6705.	2554.	1001.	1141.	140.	26.	20.	16.
15 :	16.	17.	2181.	5196.	2214.	704.	2721.	758.	550.	487.	26.	20.	16.
16 :	11.	13.	13.	1605.	3984.	1452.	221.	635.	441.	271.	132.	20.	16.
17 :	17.	8.	9.	10.	1224.	2721.	564.	8.	252.	271.	132.	20.	16.
18 :	11.	13.	6.	7.	7.	822.	1244.	109.	6.	117.	132.	20.	16.
19 :	9.	8.	10.	4.	5.	5.	316.	396.	3.	4.	8.	20.	16.
20 :	6.	7.	6.	7.	2.	3.	3.	3.	234.	2.	2.	6.	16.
2+ :	875047.	558846.	480410.	482987.	396719.	554975.	406997.	282919.	224701.	181335.	266938.	239725.	240501.
3+ :	807788.	529363.	402491.	336612.	343858.	230828.	365354.	237190.	126947.	109073.	67018.	184329.	161812.
4+ :	460211.	477184.	378442.	274262.	228169.	188994.	115577.	206073.	102335.	48550.	26081.	25795.	117360.
5+ :	414405.	251732.	337617.	256106.	184958.	118367.	89509.	55765.	89980.	40241.	11768.	6953.	14200.

Table 19:

## 4T Herring Spring Spawners :Fishing Mortality

YEAR :	71	72	73	74	75	76	77	78	79	80	81	82	83
AGE :													
2 :	0.053	0.003	0.022	0.035	0.033	0.060	0.091	0.420	0.279	0.368	0.031	0.020	0.011
3 :	0.233	0.045	0.081	0.167	0.293	0.273	0.308	0.724	0.886	1.242	0.576	0.230	0.360
4 :	0.178	0.144	0.069	0.223	0.663	0.604	0.373	0.676	0.700	1.173	0.862	0.386	0.392
5 :	0.323	0.227	0.246	0.062	0.350	0.565	0.468	0.443	0.849	0.985	0.965	0.340	0.450
6 :	0.098	0.188	0.395	0.268	1.409	0.482	0.623	0.650	0.354	1.289	0.836	0.690	0.428
7 :	0.242	0.045	0.220	0.460	0.421	0.122	0.211	0.482	0.641	1.397	2.157	0.513	0.324
8 :	0.411	0.160	0.110	0.378	0.631	0.356	0.172	0.839	0.523	1.167	1.800	1.181	0.225
9 :	0.383	0.218	0.134	0.153	0.597	0.640	0.456	0.096	0.314	1.731	3.416	2.099	0.162
10 :	0.966	0.207	0.165	0.071	0.196	0.660	0.687	0.502	0.561	1.102	1.667	0.055	0.094
11 :	1.231	0.129	0.168	0.069	0.186	0.674	1.019	0.278	0.641	1.052	1.667	0.055	0.072
12 :	1.457	0.180	0.119	0.077	0.192	0.626	1.152	0.278	0.496	1.177	2.254	0.055	0.072
13 :	0.946	0.254	0.143	0.080	0.206	0.647	0.989	0.534	0.496	1.477	3.096	0.055	0.072
14 :	0.050	0.117	0.203	0.078	0.228	0.702	1.015	0.398	0.651	1.477	0.043	0.055	0.072
15 :	0.069	0.065	0.106	0.065	0.221	0.960	1.256	0.342	0.507	1.102	0.043	0.055	0.072
16 :	0.106	0.092	0.086	0.071	0.181	0.745	3.136	0.725	0.286	0.516	1.667	0.055	0.072
17 :	0.065	0.147	0.125	0.117	0.198	0.583	1.444	0.151	0.570	0.516	1.667	0.055	0.072
18 :	0.108	0.086	0.214	0.178	0.164	0.756	0.945	3.370	0.222	2.433	1.667	0.055	0.072
19 :	0.125	0.151	0.117	0.343	0.271	0.245	4.528	0.325	0.442	0.361	0.141	0.055	0.072
20 :	0.194	0.178	0.221	0.164	0.688	0.477	0.413	0.497	0.628	1.111	0.749	0.204	0.072
MEAN :	0.381	0.139	0.155	0.161	0.375	0.536	1.015	0.617	0.529	1.141	1.332	0.327	0.167
MEAN/POP:	0.357	0.130	0.160	0.146	0.383	0.246	0.361	0.610	0.557	0.891	0.239	0.200	0.264

Table 20:

## 4T Herring Spring Spawners :Population Biomass (tonnes)

YEAR :	71	72	73	74	75	76	77	78	79	80	81	82	83
AGE :													
2 :	5044.	2211.	6779.	13906.	4757.	33711.	3831.	4299.	6061.	6720.	24790.	6481.	11174.
3 :	35800.	7305.	3391.	9976.	17816.	7405.	39215.	4668.	3396.	8473.	7082.	26951.	7557.
4 :	8474.	46669.	7512.	3667.	7994.	14832.	4823.	30362.	2236.	1496.	3321.	3806.	22798.
5 :	11950.	7311.	34997.	7418.	2724.	4501.	7462.	3572.	14645.	1106.	583.	1223.	2549.
6 :	26586.	8782.	5466.	28137.	6380.	1888.	2246.	4749.	2025.	5482.	489.	194.	750.
7 :	12077.	25249.	6131.	3284.	19094.	1301.	944.	1135.	1994.	1346.	1712.	155.	87.
8 :	13582.	9215.	19683.	4558.	1773.	10466.	971.	743.	617.	980.	329.	140.	91.
9 :	14978.	8561.	6609.	14903.	2534.	788.	5845.	818.	278.	311.	286.	37.	42.
10 :	2638.	9310.	5520.	4748.	10766.	1203.	339.	3516.	615.	173.	49.	6.	5.
11 :	8040.	939.	7176.	4016.	3941.	7773.	507.	169.	1894.	346.	55.	9.	6.
12 :	25045.	2349.	766.	5178.	3438.	2928.	3582.	176.	109.	854.	93.	8.	6.
13 :	3672.	4776.	1607.	557.	3923.	2323.	1281.	927.	109.	54.	216.	8.	6.
14 :	9.	1168.	3033.	1140.	421.	2615.	996.	390.	445.	54.	10.	8.	6.
15 :	6.	7.	850.	2027.	863.	275.	1061.	296.	215.	190.	10.	8.	6.
16 :	4.	5.	5.	642.	1594.	581.	88.	254.	176.	108.	53.	8.	6.
17 :	7.	3.	4.	4.	490.	1089.	226.	3.	101.	108.	53.	8.	6.
18 :	4.	5.	2.	3.	3.	329.	498.	44.	2.	47.	53.	8.	6.
19 :	4.	3.	4.	2.	2.	2.	126.	158.	1.	1.	3.	8.	6.
20 :	2.	3.	2.	3.	1.	1.	1.	1.	94.	1.	1.	2.	6.
2+ :	167925.	133871.	109537.	104169.	88514.	94009.	74043.	56278.	35013.	27853.	39188.	39069.	45115.
3+ :	162881.	131660.	102758.	90263.	83757.	60298.	70211.	51979.	28952.	21133.	14398.	32588.	33941.
4+ :	127080.	124355.	99367.	80287.	65940.	52893.	30996.	47312.	25556.	12659.	7316.	5637.	26385.
5+ :	118606.	77687.	91855.	76620.	57946.	38062.	26174.	16950.	23320.	11164.	3995.	1831.	3586.

Table 21:

4T Herring Fall Spawners :Fishing Mortality				PROJECTIONS
YEAR :	84	85	86	
AGE :				
2 :	0.000	0.000	0.000	
3 :	0.069	0.069	0.069	
4 :	0.216	0.216	0.216	
5 :	0.288	0.288	0.288	
6 :	0.300	0.300	0.300	
7 :	0.270	0.270	0.270	
8 :	0.237	0.237	0.237	
9 :	0.198	0.198	0.198	
10 :	0.180	0.180	0.180	
11 :	0.180	0.180	0.180	
12 :	0.180	0.180	0.180	
13 :	0.180	0.180	0.180	
14 :	0.180	0.180	0.180	
15 :	0.180	0.180	0.180	
16 :	0.180	0.180	0.180	
17 :	0.180	0.180	0.180	
18 :	0.180	0.180	0.180	
19 :	0.180	0.180	0.180	
20 :	0.180	0.180	0.180	
MEAN :	0.187	0.187	0.187	
MEAN/POP:	0.142	0.138	0.137	

Table 22:

4T Herring Fall Spawners :Population (1000's)				PROJECTIONS
YEAR :	84	85	86	
AGE :				
2 :	114500.	114500.	114500.	
3 :	94867.	93657.	93658.	
4 :	51902.	72488.	71568.	
5 :	73532.	34233.	47819.	
6 :	24884.	45126.	21014.	
7 :	28914.	15089.	27371.	
8 :	5577.	18067.	9430.	
9 :	5183.	3602.	11671.	
10 :	2088.	3481.	2419.	
11 :	427.	1428.	2380.	
12 :	1159.	292.	976.	
13 :	4.	793.	200.	
14 :	4.	3.	542.	
15 :	4.	3.	2.	
16 :	4.	3.	2.	
17 :	4.	3.	2.	
18 :	4.	3.	2.	
19 :	4.	3.	2.	
20 :	4.	3.	2.	
2+ :	403066.	402774.	403559.	
3+ :	288566.	288274.	289059.	
4+ :	193699.	194617.	195401.	

Table 23:

4T Herring Fall Spawners :Population Biomass (tonnes)		PROJECTIONS		
YEAR :	84	85	86	
AGE :				
2 :	12824.	12824.	12824.	
3 :	16033.	15828.	15828.	
4 :	12768.	17832.	17606.	
5 :	20883.	9722.	13581.	
6 :	7938.	14395.	6703.	
7 :	10294.	5372.	9744.	
8 :	1991.	6450.	3367.	
9 :	1861.	1293.	4190.	
10 :	812.	1354.	941.	
11 :	168.	561.	935.	
12 :	452.	114.	381.	
13 :	2.	309.	78.	
14 :	2.	1.	211.	
15 :	2.	1.	1.	
16 :	2.	1.	1.	
17 :	2.	1.	1.	
18 :	2.	1.	1.	
19 :	2.	1.	1.	
20 :	2.	1.	1.	
2+ :	86036.	86062.	86393.	
3+ :	73212.	73238.	73569.	
4+ :	57179.	57410.	57741.	
5+ :	44411.	39578.	40136.	

Table 24:

4T Herring Fall Spawners :Catch Biomass (tonnes)		PROJECTIONS		
YEAR :	84	85	86	
AGE :				
2 :	11.	11.	11.	
3 :	971.	958.	958.	
4 :	2258.	3151.	3111.	
5 :	4763.	2216.	3095.	
6 :	1875.	3398.	1583.	
7 :	2219.	1157.	2099.	
8 :	383.	1238.	646.	
9 :	304.	211.	684.	
10 :	122.	203.	141.	
11 :	25.	84.	140.	
12 :	68.	17.	57.	
13 :	0.	46.	12.	
14 :	0.	0.	32.	
15 :	0.	0.	0.	
16 :	0.	0.	0.	
17 :	0.	0.	0.	
18 :	0.	0.	0.	
19 :	0.	0.	0.	
20 :	0.	0.	0.	
2+ :	13000.	12691.	12569.	
3+ :	12989.	12681.	12558.	
4+ :	12018.	11723.	11600.	
5+ :	9761.	8572.	8489.	

Table 25:

4T Herring Spring Spawners :Fishing Mortality		PROJECTIONS		
YEAR :	84	85	86	
AGE :				
2 :	0.006	0.007	0.007	
3 :	0.200	0.240	0.240	
4 :	0.217	0.261	0.261	
5 :	0.250	0.300	0.300	
6 :	0.237	0.285	0.285	
7 :	0.180	0.216	0.216	
8 :	0.125	0.150	0.150	
9 :	0.090	0.108	0.108	
10 :	0.052	0.063	0.063	
11 :	0.040	0.048	0.048	
12 :	0.040	0.048	0.048	
13 :	0.040	0.048	0.048	
14 :	0.040	0.048	0.048	
15 :	0.040	0.048	0.048	
16 :	0.040	0.048	0.048	
17 :	0.040	0.048	0.048	
18 :	0.040	0.048	0.048	
19 :	0.040	0.048	0.048	
20 :	0.040	0.048	0.048	
MEAN :	0.092	0.111	0.111	
MEAN/POP:	0.149	0.179	0.174	

Table 26:

4T Herring Spring Spawners :Population (1000's)		PROJECTIONS		
YEAR :	84	85	86	
AGE :				
2 :	78000.	78000.	78000.	
3 :	63708.	63463.	63384.	
4 :	25391.	42706.	40873.	
5 :	57099.	16725.	26932.	
6 :	5476.	36409.	10144.	
7 :	1540.	3536.	22417.	
8 :	160.	1053.	2333.	
9 :	175.	116.	742.	
10 :	82.	131.	85.	
11 :	9.	64.	100.	
12 :	12.	7.	50.	
13 :	12.	10.	5.	
14 :	12.	10.	7.	
15 :	12.	10.	7.	
16 :	12.	10.	7.	
17 :	12.	10.	7.	
18 :	12.	10.	7.	
19 :	12.	10.	7.	
20 :	12.	10.	7.	
2+ :	231749.	242286.	245118.	
3+ :	153749.	164286.	167118.	
4+ :	90041.	100823.	103734.	
5+ :	64651.	58117.	62862.	

Table 27:

4T Herring Spring Spawners :Population Biomass (tonnes)				PROJECTIONS
YEAR :	84	85	86	
AGE :				
2 :	11076.	11076.	11076.	
3 :	10830.	10789.	10775.	
4 :	5611.	9438.	9033.	
5 :	13875.	4064.	6545.	
6 :	1424.	9466.	2638.	
7 :	496.	1139.	7218.	
8 :	54.	358.	793.	
9 :	63.	42.	267.	
10 :	31.	49.	32.	
11 :	3.	25.	39.	
12 :	5.	3.	19.	
13 :	5.	4.	2.	
14 :	5.	4.	3.	
15 :	5.	4.	3.	
16 :	5.	4.	3.	
17 :	5.	4.	3.	
18 :	5.	4.	3.	
19 :	5.	4.	3.	
20 :	5.	4.	3.	
2+ :	43507.	46478.	48458.	
3+ :	32431.	35402.	37382.	
4+ :	21601.	24614.	26606.	
5+ :	15990.	15176.	17574.	

Table 28:

4T Herring Spring Spawners :Catch Biomass (tonnes)				PROJECTIONS
YEAR :	84	85	86	
AGE :				
2 :	63.	75.	75.	
3 :	1785.	2095.	2092.	
4 :	998.	1974.	1889.	
5 :	2793.	959.	1545.	
6 :	274.	2138.	596.	
7 :	74.	201.	1275.	
8 :	6.	45.	100.	
9 :	5.	4.	25.	
10 :	1.	3.	2.	
11 :	0.	1.	2.	
12 :	0.	0.	1.	
13 :	0.	0.	0.	
14 :	0.	0.	0.	
15 :	0.	0.	0.	
16 :	0.	0.	0.	
17 :	0.	0.	0.	
18 :	0.	0.	0.	
19 :	0.	0.	0.	
20 :	0.	0.	0.	
2+ :	6000.	7496.	7603.	
3+ :	5937.	7421.	7528.	
4+ :	4152.	5326.	5435.	
5+ :	3155.	3353.	3547.	

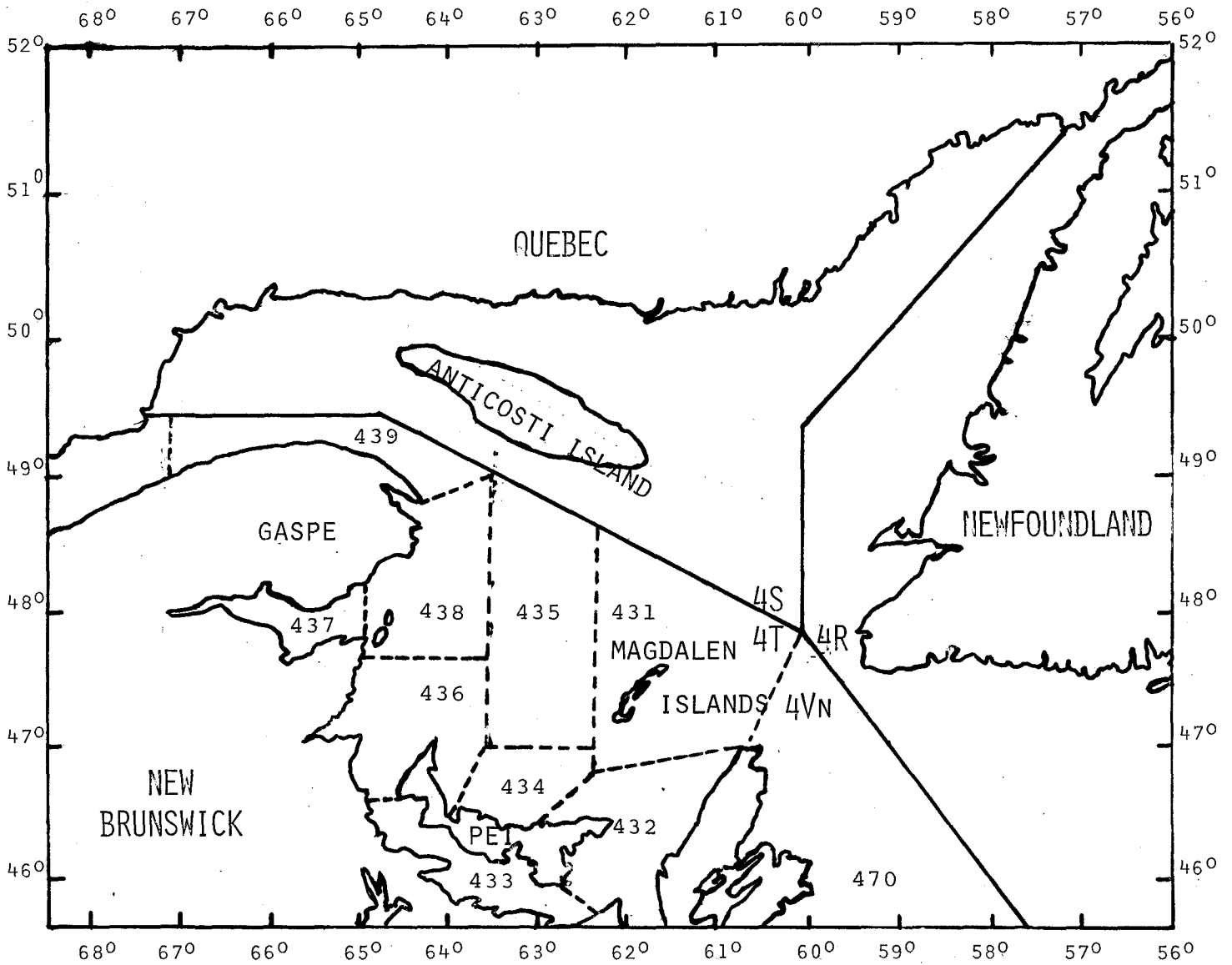


Fig. 1. Map showing statistical unit areas for the Southern Gulf of St. Lawrence.



Figure 2: Spring gillnet catch rates of 3 year old herring against age 3 population abundance from VPA, 1975 to 1982. The dashed lines indicate the abundance estimated from the 1983 catch rate.  
 $F_t = 0.45$ .  $Y = 1615.56 + 890.74X$ .  $R = 0.90$ .

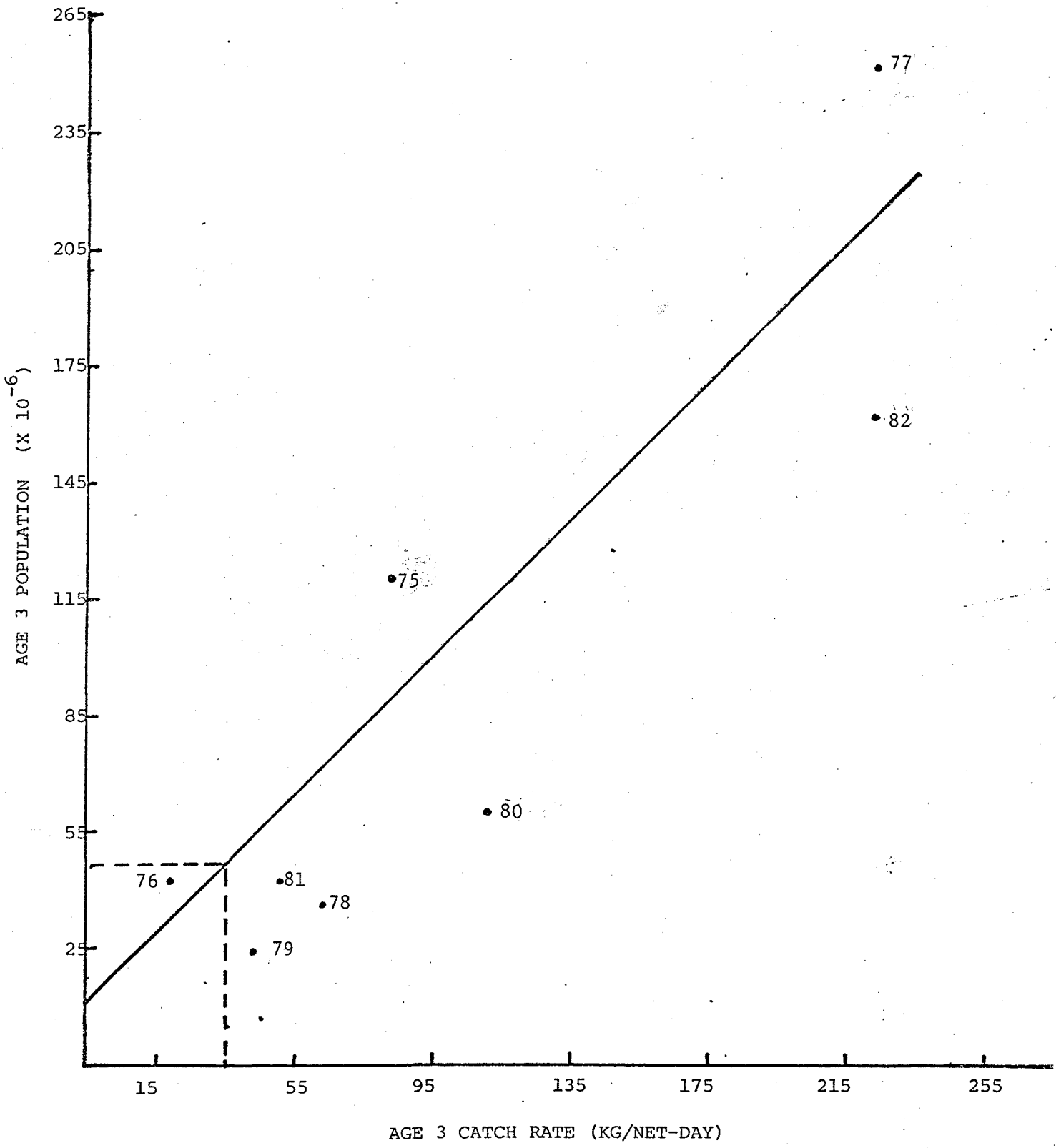


Figure 3: Fall gillnet catch rates against 4+ Biomass from VPA, 1975 to 1983.  $F_t = 0.35$ .  $Y = 4655.9 + 204.02X$ .  $R = 0.93$ .

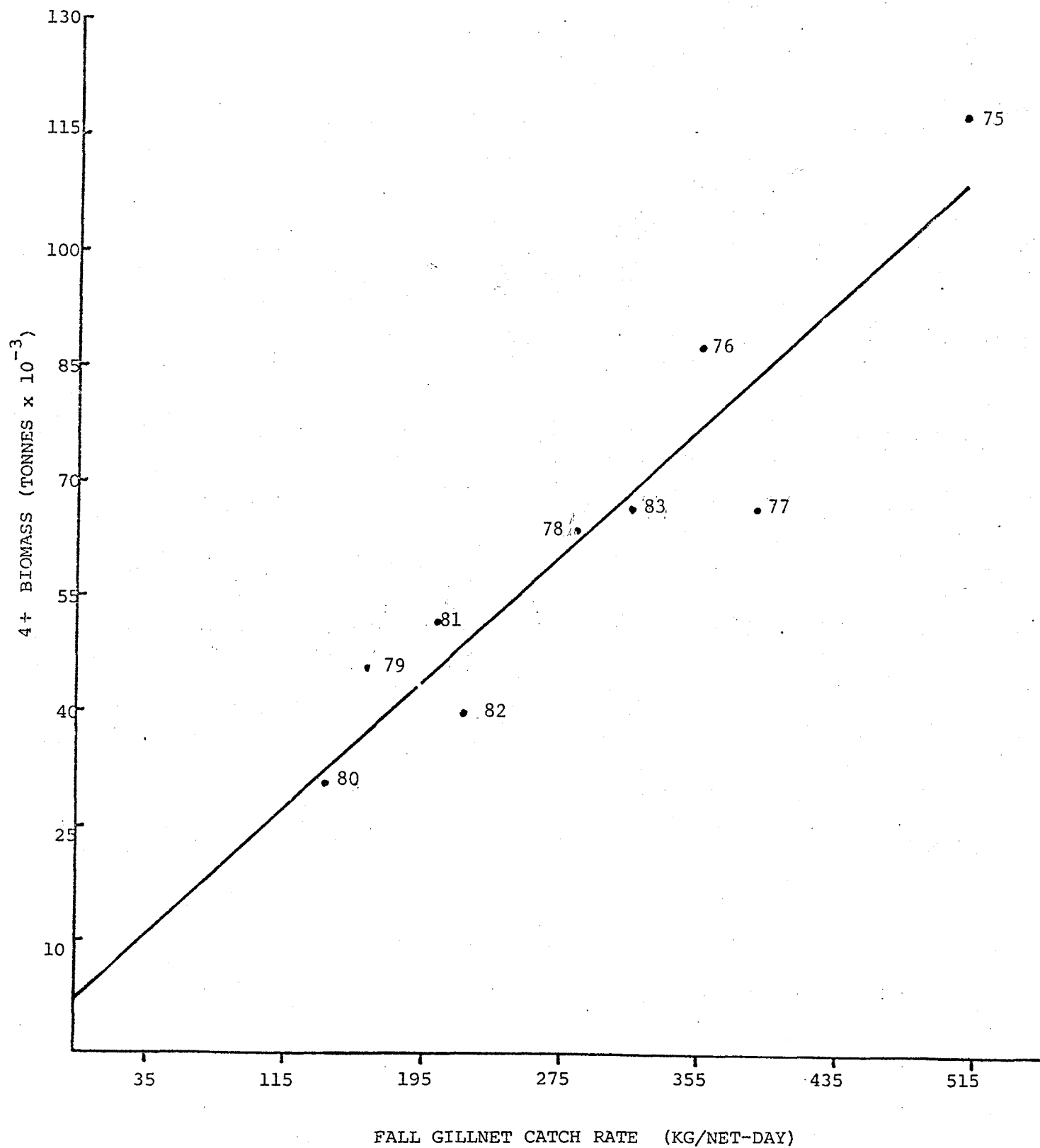
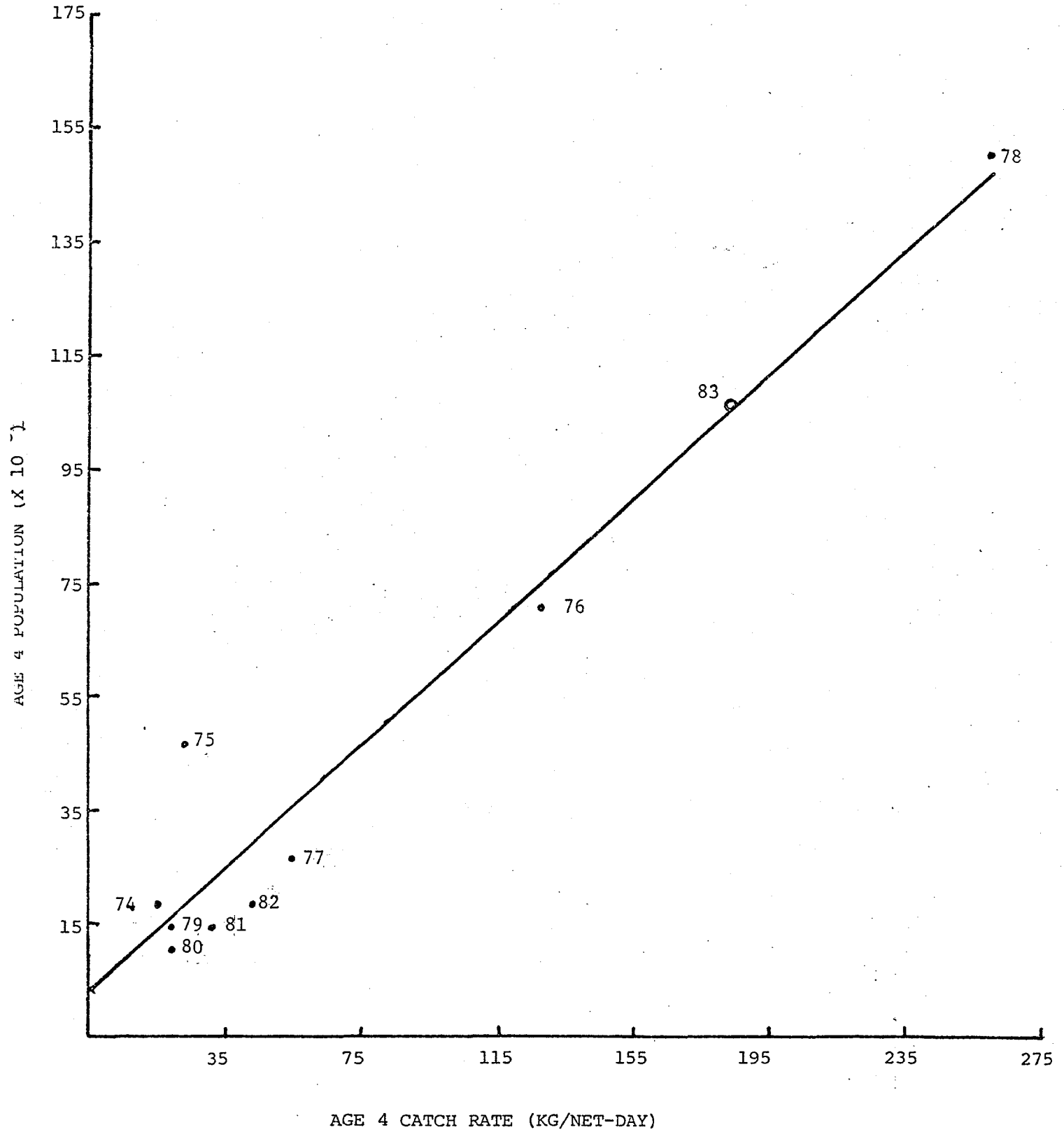


Figure 4: Spring gillnet catch rates of 4 year old herring against age 4 population abundance from VPA, 1974 to 1982. The 1983 point is not included in the regression.  $F_t = 0.45$   $Y = 5354.45 + 549.07X$   
 $R = 0.97$



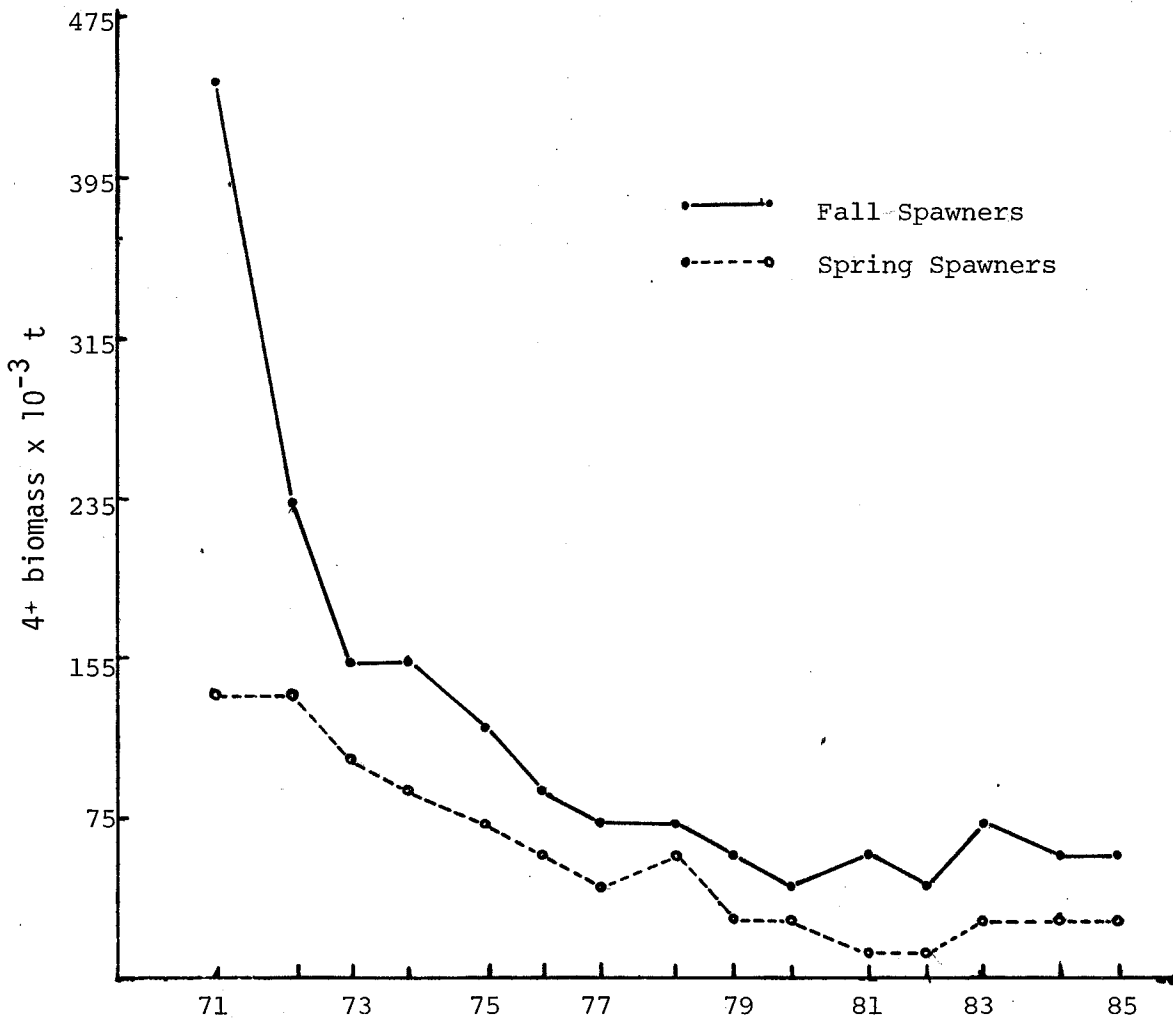


Figure 5: 4 + Biomass of Spring and Fall Spawners from sequential population analysis (1971 - 1983) and projections.