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Status of the Scotian Shelf Silver Hake (Whiting) Population in 1991 with Projections to 1993

by

D. E. Waldron, M. A. Showell and M. C. Bourbonnais

Marine Fish Division, Dept. of Fisheries and Oceans
Bedford Institute of Oceanography, P. O. Box 1006
Dartmouth, Nova Scotia, Canada B2Y 4A2

Introduction

Management and Current Fishery

The silver hake fishery on the Scotian Shelf has traditionally been pursued by large (TC 7) non-Canadian fishing vessels using bottom trawls; Cuba, USSR, and Japan have been customary participants. Under Canadian fishing regulations, in place since 1977, catches are restricted to the seaward side of the Small Mesh Gear Line (Figure 1), and are highest during the period April to July of each year, in NAFO Div. 4W. The fishery opens April 1 and closes November 15 each year. In recent years experiments have been conducted to determine the feasibility of moving the starting date of the fishery to early March. Results of these studies are under consideration. Since 1990 attempts have been made to boost Canadian participation in fishing this species. However, attempts by Canadian fishing vessels to catch this species have met with mixed success, as long distances to the fishing ground and deeper water preferred by silver hake caused difficulty for smaller vessels. In 1991 a different strategy was employed; many Canadian companies negotiated charter arrangements with fishing companies of Cuba and the CIS (formerly USSR) to fish Canadian allocations using TC 7 vessels. These arrangements were much more successful, and have continued into 1992. As a result national allocations have been reduced. However, because of the charter arrangements the overall fleet composition of the fishery has remained the same as in previous years.

Historical catches for this fishery have ranged from 300,000 tons in 1973 to 36,000 tons in 1983. There was a steady decrease in silver hake catch from 1973 to 1981 (Table 1). Nominal catches from 1977 until 1983 fluctuated between 33 and 60 thousand tons. In recent years catches have declined, to approximately 68,000 mt in 1991. Below are reported catches ('000 t) and the Total Allowable Catch (TAC '000 t) since 1977.

YEAR	'77	'78	'79	'80	'81	'82	'83	'84	'85	'86	'87	'88	'89	'90	'91	'92
Advice	70	80	70	90	80	80	80	100	100	100	100	161	235		100	105
TAC	70	80	70	90	80	80	80	100	100	100	100	120	135	135	100	105
Catch	37	48	52	45	45	60	36	74	75	83	62	74	91[1]	69[1]	68[1]	24[2]

[1] Preliminary
[2] as of May 25, 1992.

Since 1976, the low level of catches against TAC is due in part to the proportion of the TAC allocated to various fleets. A more informative method of viewing the post-1976 catches is to examine the ratio of silver hake allocation vs catch; viewed in this manner percentages of total allocations caught by non-Canadian fleets have ranged from 64% to 90%.

Input Data

Commercial Sampling

Sampling for length of the commercial catch in 1991 was conducted by the Canadian Observer Program (IOP) while otoliths were collected by both Canadian and CIS (Russian) scientists and technicians. More than 2000 samples consisting of 557,000 lengths and 4000 otolith pairs were collected from the fishery. The Canadian sampling summary is presented in Table 2.

Each country aged their own otoliths using the ICNAF standards (Anon., 1977). These age readings were used in the provision of a single fishing season age length key.

Catch-at-age

The commercial catch-at-age for 1991 was calculated from Canadian length sampling and ageing by both Canadian and Russian scientists. Regressions of lengths and weights from the Canadian July Research Vessel Surveys were used to calculate yearly α and β values used in the calculation of sample weights (Table 3). The catch-at-age and weight-at-age for 1977-1990 were from the previous assessment. The final catch-at-age was constructed during a Canada-RUSSIA Scientific work meeting held at the AtlantNIRO Laboratory, Kaliningrad in late March, 1992 (Table 4).

Commercial catches in 1983, 1987 and 1990 were dominated by age 2 fish (ie. the 1981, 1985 and 1988 year classes). These three year classes were estimated to be amongst the largest in the juvenile survey series (Table 7). The fisheries in 1986, 1988, and 1991 were dominated by catches of age 3 fish (ie. the 1983, 1985, and 1988 year classes). The 1991 fishery shows the 1988 year class to be average and the 1989 year class to be below average. The 1990 year class at age 1 in 1991 is at the same size as the 1989 year class at age 1 in 1990.

Indices of Abundance

Commercial Catch and Effort: Catch Rate Standardization

The APL program STANDARD was used to standardize catch rates for the

period 1977 to 1991. Catch and effort from NAFO and the IOP were categorized in a manner similar to that used in previous assessments (Waldron *et al.*, 1991). Examination of the regression results (Table 5 and accompanying graphs) indicate that all parameters but data source have a significant effect on the model.

The standardized catch rate for this stock has dropped in recent years, from a peak of 6.1 t/hr in 1989 to 2.8 t/hr in 1991. The most recent catch rate is similar to those experienced in the late 70's and early 80's.

Abundance Surveys

Canadian Adult Surveys

The July stratified random groundfish survey (Table 6) has been conducted on the Scotian Shelf using two Canadian research vessels (Lady Hammond, 1977-81; and the Alfred Needler, 1982 to present). Fanning (1985) indicated that a conversion factor of 2.3 should be applied to the series prior to 1982. This adjustment is assumed to account for the effect of vessel and gear changes in the time series.

The survey results indicate a continual decline in total numbers since 1986 with some stabilization in the most recent years (Figure 2). The 1991 survey shows a below average 1990 and average 1989 year classes at age 1 and 2. The strong 1988 year class at age 1 in 1989 and age 2 in 1990 is below average at age 3 in the 1991 survey.

Silver hake juvenile survey

As in previous years, a fall survey for juvenile silver hake was conducted as a cooperative research venture between BIO (Canada) and AtlantNiro (RUSSIA). The time series of this survey (1981 to present) provides an important index of pre-recruitment abundance for this species. The survey index based on the core strata (60-78) (Koeller et al., 1984) is presented in Table 7.

A comparison of age 0 numbers from the juvenile survey to the corresponding year class (age 1) as estimated by the July R/V survey and the commercial catch shows reasonable correspondence (Figure 3) except in the estimate of the 1990 year class size.

For 1991, coverage of the survey area was complete, with 71 core strata stations (60 - 78) sampled (Figure 4). The 1991 stratified mean catch per tow was amongst the lowest in the time series at 78.6. This value is of a similar magnitude to that of the poorly recruited 1984 and 1987 year classes.

Growth

Growth rates for this species have remained relatively stable over the last 10 years

(Figure 5 and Table 8).

Estimation of Parameters

Sequential Population Analysis

Sequential Population models have been used to assess the silver hake stock since 1977. This assessment used the ADAPTive framework (Gavaris, 1988) and included a dome shaped partial recruitment pattern achieved by setting F at age 9 to 10% of that on the fully recruited ages 3-5 (after Waldron et. al 1990, 1991). Canadian commercial catch-at-age, age disaggregated CPUE, Canadian July Survey catch-at-age and the juvenile index were included in the analysis. Ages 3-5 were assumed fully recruited and ages 1-8 were included in the calibration block (see Adapt Formulation section). Below is that formulation and the results are in Table 9.

1) Catch at Age extends from 1977 to 1991 and Ages 1 to 9
   The Catch at Age did NOT contain a PLUS Group
2) Partial Recruitment -* indicates ages used to calculate mean fully recruited F.

Ages		PR
1		0.020
2		0.249
3	*	1.000
4	*	1.000
5	*	1.000
6		0.775
7		0.550
8		0.325
9		0.100

3) Natural Mortality was set at 0.4

4) F's over Ages 1 to 8 will be estimated starting from:

Ages	F
1	0.010
2	0.126
3	0.515
4	0.515
5	0.515
6	0.397
7	0.280
8	0.165

5) Mortality at age 9 was 10% of that for fully recruited ages.
6) Research Survey Estimates of Abundance for ages 1 to 8 were given.
   No standard errors were applied. Log transformation used.
   There were 2 age disaggregated series used for tuning.

Survey	Month	Year														
July R/V	7	'77	'78	'79	'80	'81	'82	'83	'84	'85	'86	'87	'88	'89	'90	'91
Age Disaggregated CPUE	5	'77	'78	'79	'80	'81	'82	'83	'84	'85	'86	'87	'88	'89	'90	'91

7) The Lower Limit for Estimated Numbers at Age was the CATCH
   Upper Limit for Estimated Numbers at age was 10000000
8) The Lower Limit for RV survey slope was 0
   The Upper Limit for RV survey slope was 9000

Several other formulations were tested and the results suggested that this model gave the best diagnostics. All other parameter estimates were also significant (Table 9). Using the equations of Ratkowsky (1983) for calculating the bias of functions of parameters. The inclusion of the juvenile index reduced the bias estimate on age 1 and resulted in the parameter estimate for age 1 being significant. The final bias estimates for terminal estimates was in the range of 2-12%.

Population numbers and biomass are shown in Table 10.

As noted by Waldron et al. (1991), fishing mortalities greater than 1 were estimated for ages 4 5 6 in 1989 (Table 10). Fishing mortalities greater than 1 were also noted for other year classes throughout the matrix. This is not an uncommon observation, however the 1989 mortalities on ages 4-6 are disturbing but not very important in such a short lived species like silver hake where ages 4-6 usually contribute less than 10% of the population and catch.

Adapt Formulation

The parameters used in the model were:

Parameters:

- Year class estimates
  $N_{i,1991}$ i = 1-8
- *Calibration* coefficients for R/V numbers
  K_i i = 1-8
- Calibration coefficients for CPUE-at-age numbers/hour
  K_i i = 1-8
- Calibration coefficients for Juvenile R/V survey numbers
  K_i i = 1

Structure:

- Natural mortality = 0.4.
- Error in catch-at-age assumed negligible.
- F on oldest age (age 9) set equal to 10% of weighted (by population) F on age 3-5.
- intercepts not fitted.

Input:

- Catch-at-age
  $C_{i,t}$ i = 1-9 t = 1977-91
- Otter trawl (TC 7) CPUE-at-age
  $CPUE_{i,t}$ i = 1-9 t = 1977-91
- Research Vessels
  $RV_{i,t}$ i = 1-9 t = 1977-91
  $JV_{i,t}$ i = 1 t = 1981-91
- Log of surveys and CPUE

Objective function:

$$-Minimize \sum_i \sum_j ((obs \ln JV_t - pred \ln JV_t)^2)$$
$$+\left(\left(obs \ln RV_{j,t} - pred \ln RV_{j,t}\right)^2\right)$$
$$+\left(\left(obs \ln CPUE_{j,t} - pred \ln CPUE_{j,t}\right)^2\right)$$

Summary:

- number of observations = 255
- number of parameters = 25

Yield-per-recruit

Results form the previous yield-per-recruit analysis were used (Waldron et al., 1990 and 1991). Input data are presented below. That analysis estimated $F_{0.1}$ to be 0.72 with a corresponding yield-per-recruit of 0.060 kg. F_{max} (>4.0) was not well defined.

Age	Average Weight (kg)	Partial Recruitment
1	0.057	0.035
2	0.137	0.235
3	0.182	1.000
4	0.224	1.000
5	0.259	1.000
6	0.308	0.761
7	0.411	0.381
8	0.525	0.141
9	0.665	0.078

Assessment Results

Population estimates are presented in Table 10. The 1990 year class at age 1 in 1991 is not as large as anticipated from the juvenile survey index. From the juvenile survey index the 1989 year class was expected to be weak. In the population estimates the 1989 year class at age 2 in 1991 is estimated to be the same size as the weak 1987 year class at age 2 in 1989. Similarly, the juvenile and July R/V survey suggested the 1988 year class was strong. In this population estimate the 1988 year class at age 3 is estimated to be the same size as the strong 1983 year class at age 3 in 1986. Then the 1991 population is composed of a lower than expected 1990, a weak 1989 and a strong 1988 year classes.

Prognosis

Commercial catch rates since 1982 are well above those of the late 1970's. However, the CPUE for 1988, 1990 and 1991 are approaching those estimated for the period 1977-81. The July adult survey shows a decline in the population numbers since 1986 to a level similar to that estimated for 1983. There is a leveling of this trend for 1988 to 1990 with the estimate for 1991 being the lowest since 1980.

The fall juvenile survey agrees well with the July adult survey age 1 estimates for all years except 1990. This suggests that the fall juvenile survey is a good indicator of the relative strength of incoming recruitment. The 1990 year class is the 6th highest in the series and is similar to that of the 1986 and 1988 year classes. The juvenile survey results would imply above average contribution to the 1991 and 1992 fisheries for this year class. This should be tempered with the lower estimates for this year class suggested by the July R/V and Commercial catch data. The estimate of the 1991 year class size suggests poor recruitment to the 1992 fishery.

The 1992 fishery should be composed of an above average 1990 year class which should dominate the catch, a moderate 1989 year class at age 3 and an above average 1988 year class at age 4. The 1991 catch was average while the CPUE was the lowest seen since the early 1980's. This fishery was dominated by the large 1988 year class which will contribute marginally to the fishery in 1992 and 1993.

Catch Projections

Based on the information available, the 1990 year class was considered average, and the 1991 year class was between the 1984 and 1987 year classes in the juvenile survey (ie slightly below average). Based on the SPA analysis these were estimated to be 1.1 billion and 0.84 billion at age 1. The 1992 year-class was set equal to the geometric mean (1981-1990) of 1.1 billion fish, from SPA.

The weight at age for projections was the average of 1977-1991 while the partial recruitment at age was averaged from 1986-90. Projection parameters are summarized:

Age	Jan 1, 1992 population numbers ('000)	Average weight (kg)	Partial Recruitment
1	840,099	0.058	0.017
2	739,216	0.142	0.219
3	353,717	0.192	1.000
4	147,204	0.234	1.000
5	36,662	0.272	1.000
6	12,069	0.328	1.000
7	3,593	0.430	0.399
8	802	0.540	0.246
9	614	0.681	0.073

Based on early indications from the 1992 fishery, STACFIS assumed that the 1992 catch would be about 40,000t. A projection, using these data, indicates that the $F_{0.1}$ catch in 1993 would be 75,000t (Table below).

Silver hake catch projections

1993 Catch (tons)	Population Numbers (1.1.1993) ('000)	Population Biomass (mid-year) (t)
74,645	2,371,415	205,226

Other Estimates of 1993 Catch

Status quo methods to estimate the size of the 1993 catch were investigated. These are described in the "Cooperative Research Report ICES Doc. 133, Sept. 1985". The SHOT method using catch and recruitment from R/V suggest a 1993 catch of 57,000t while the use of simple regression techniques give a 1993 catch estimate ranging from 40,000 to 60,000 tons.

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Table 1. Nominal catches for 4VWX silver hake 1970-1991 (1989-1991 preliminary).

	Year								
Country	1970	1971	1972	1973	1974	1975	1976	1977	1978
Bulgaria	0	0	0	0	0	1722	3088	862	606
Canada	0	0	0	0	11	101	26	10	26
Cuba	0	0	201	0	0	1724	12572	1847	3436
France	0	0	0	0	0	0	0	15	0
FRG	0	0	10	0	296	106	97	684	0
GDR	0	0	0	0	0	0	0	0	3[1]
Ireland	0	0	0	0	0	108	106	0	0
Italy	0	0	0	0	0	0	0	38	106
Japan	129	8	63	88	67	54	78	19	161
Poland	0	0	0	0	0	0	0	295	2
Portugal	0	0	0	0	0	0	0	0	0
Romania	0	0	0	0	0	0	0	10	0
Spain	0	15	0	0	0	6	0	0	2
USA	0	1	0	0	0	7	1	14	0
USSR	168916	128633	113774	298533	95371	112566	81216	33301	44062
TOTAL	169045	128657	114048	298621	95745	116394	97184	37095	48404

Country	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991
Bulgaria	4639	817	0	0	0	0	0	0	0	0	0	0	0
Canada	13	104	6	38	15	10	2	9	11[3]	9[3]	337[3]	0	68[3]
Cuba	1798	2287	642	11969	7418	14496	17683	16041	20219	9016	14222[2]	13596[3]	17786[1]
France	0	0	0	2[1]	0	0	0	0	0	0	0	0	0
FRG	0	0	0	0	0	0	0	0	0	0	0	0	0
GDR	0	0	0	0	0	93	0	0	0	0	0	0	0
Ireland	9	0	0	0	0	0	0	0	0	0	0	0	0
Italy	5	0	541	37[1]	2[2]	0	0	0	0	0	0	0	0
Japan	219	239	120	937	649	530	120	67	145	0	194[3]	322[1]	744[1]
Poland	0	0	1[3]	31[2]	0	0	0	0	0	0	0	0	0
Portugal	0	56	2044	2[1]	378	1714	1338	0	0	0	0	0	0
Romania	1	0	0	0	0	0	0	0	0	0	0	0	0
Spain	0	40	0	0	0	0	0	0	0	0	0	0	0
USA	0	0	3	2	0	0	0	1	0	0	0	0	0
USSR	45076	40982	41243	47261	27377	57423	56337	66571	41329	65349	76752[2]	54658[3]	49311[1]
TOTAL	51760	44525	44600	60251	35839	74266	75480	82689	61704	74374	91505	68582	67848[1]

[1] Observer Program Data (data not reported to NAFO)

[2] FLASH data

[3] NAFO Circular Letters and provisional reporting to NAFO.

Table 2 .Sampling used in this assessment.

Year	No. Lengths	No. Ages
1977	34379	600
1978	137468	674
1979	101908	1108
1980	247369	1462
1981	195493	987
1982	160878	1152
1983	134226	986
1984	203314	1255
1985	216912	1163
1986	197654	1311
1987	377527	681
1988	309767	1158
1989	300100	1135
1990	447587	1817
1991	556765	1712

Table 3: Male and Female Alpha and Beta's used in the construction of the silver hake catch at age used in this assessment. Lengths (cm) and weights (kg) used were from the Canadian July Research Vessel Survey of the Scotian Shelf (4VWX).

Year	Male Alpha	Female Alpha	Male Beta	Female Beta
1977	.000006260	.000006930	3.0626	3.0350
1978	.000004630	.000003070	3.1366	3.2531
1979	.000010200	.000005880	2.9001	3.0675
1980	.000002330	.000001800	3.3417	3.3989
1981	.000006830	.000005080	3.0206	3.1172
1982	.000011600	.000006740	2.8575	3.0232
1983	.000006480	.000003320	2.9935	3.2034
1984	.000018300	.000006490	2.7052	3.0284
1985	.000013500	.000004530	2.7848	3.1235
1986	.000007970	.000003820	2.9384	3.1685
1987	.000009990	.000004240	2.8798	3.1456
1988	.000014300	.000004800	2.7942	3.1241
1989	.000006750	.000004440	3.0114	3.1416
1990	.000034320	.000021000	2.5234	2.6958
1991	.000006040	.000004265	2.9582	3.2036

Table 4. Commercial Catch Numbers at age for 4VWX silver hake (Thousands)

	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986
1	17911	20940	20569	16588	2358	20190	5849	59588	14970	45598
2	72529	70302	57893	70696	25214	52976	96852	45828	130814	70269
3	59862	80196	72891	70391	109035	75876	56158	206900	98346	229126
4	15070	35025	36669	32032	37573	68400	29282	82911	128365	84097
5	2218	12709	22380	14465	11928	31752	11388	19344	34111	28635
6	725	5227	9970	5184	3234	5945	3395	4268	9327	8760
7	97	1906	3168	1431	1201	2042	819	1038	2344	1436
8	91	1168	495	451	290	465	253	183	226	497
9	4	338	374	98	141	64	88	10	85	111

	1987	1988	1989	1990	1991
1	6804	5110	24264	6516	5738
2	214235	62791	85846	209620	117305
3	114417	265307	158745	142862	201243
4	54211	39242	145105	41215	46414
5	13063	21303	20025	11741	12154
6	6045	3106	9369	1648	3954
7	347	2133	1569	640	290
8	156	208	1166	107	181
9	117	143	39	40	50

Table 5. CPUE standardization results for the 4VWX silver hake population. Includes years 1977-1991.

Key

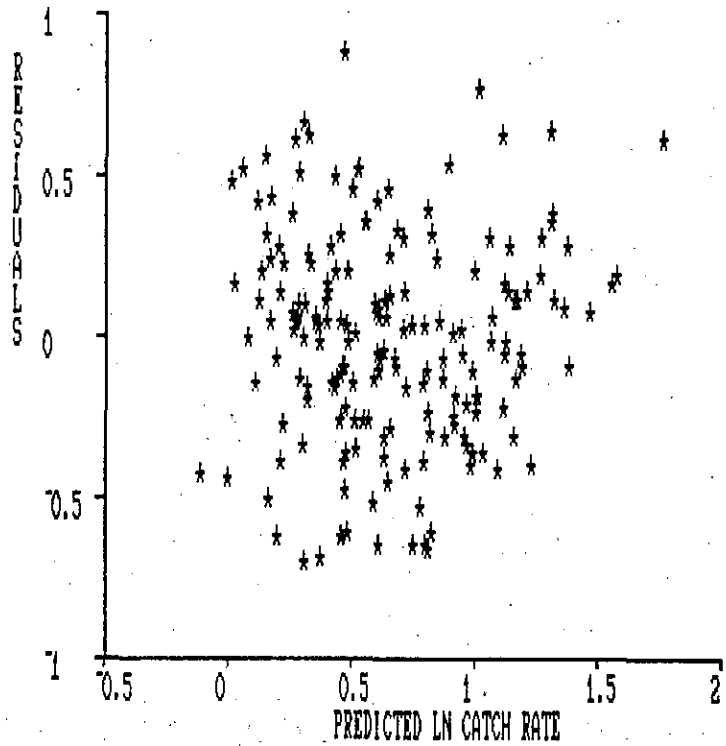
Type 1: Data Source, NAFO or IOP
Type 2: Month
Type 3: Year
Type 4: Area
Type 5: Regime either Old or New
Type 6: Country

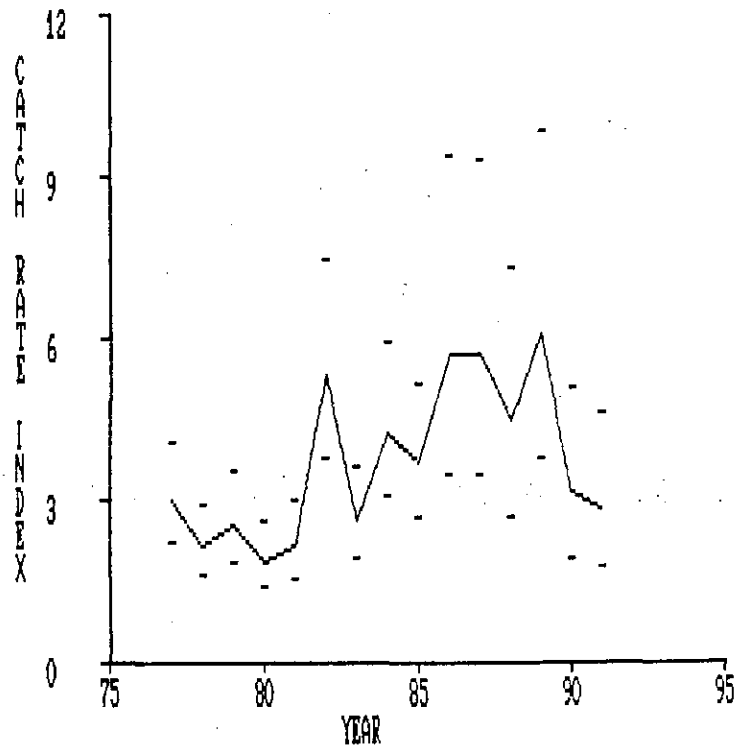
PREDICTED CATCH RATE

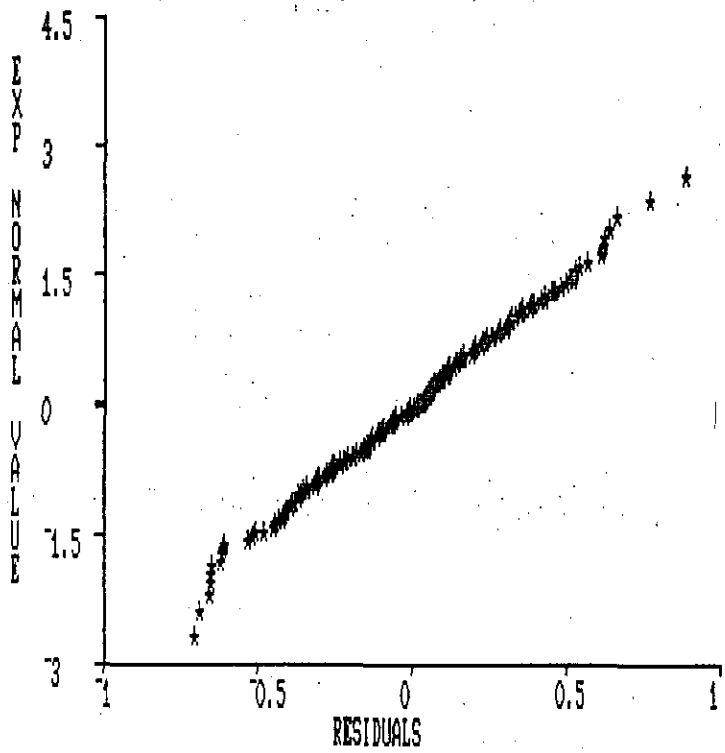
STANDARDS USED VARIABLE NUMBERS: 1 5 460 1 1

YEAR	TOTAL CATCH	PROP.	CATCH RATE MEAN	S.E.	EFFORT
77	37095	0.702	2.998	0.560	12372
78	48404	0.879	2.177	0.384	22234
79	51760	0.827	2.543	0.507	20357
80	44525	0.920	1.870	0.371	23805
81	44600	0.833	2.140	0.431	20844
82	60251	0.957	5.285	1.085	11400
83	35839	0.921	2.608	0.526	13740
84	74266	0.967	4.253	0.858	17463
85	75480	0.981	3.702	0.747	20391
86	82689	0.427	5.706	1.686	14490
87	61704	0.926	5.654	1.671	10913
88	74374	0.864	4.441	1.317	16748
89	91505	0.934	6.087	1.763	15033
90	68582	0.966	3.133	0.900	21889
91	67848	0.959	2.828	0.814	23990

AVERAGE C.V. FOR THE MEAN: .235







REGRESSION COEFFICIENTS

CATEGORY	CODE	VARIABLE	COEFFICIENT	STD. ERROR	NO. OBS.
1	1	INTERCEPT	1.054	0.188	185
2	5				
3	77				
4	460				
5	1				
6	1				
1	2	1	-0.142	0.139	103
2	3	2	0.379	0.175	5
	4	3	0.194	0.089	26
	6	4	-0.150	0.075	48
	7	5	-0.194	0.079	38
	8	6	-0.319	0.098	21
	9	7	-0.509	0.175	5
3	78	8	-0.322	0.118	26
	79	9	-0.162	0.122	21
	80	10	-0.470	0.151	9
	81	11	-0.334	0.151	9
	82	12	0.571	0.169	7
	83	13	-0.136	0.163	8
	84	14	0.352	0.162	8
	85	15	0.214	0.162	8
	86	16	0.671	0.192	10
	87	17	0.662	0.195	9
	88	18	0.421	0.198	9
	89	19	0.734	0.185	13
	90	20	0.069	0.180	16
	91	21	-0.033	0.182	16
4	450	22	0.166	0.128	10
	470	23	-0.111	0.066	46
5	2	24	-0.261	0.148	164
6	2	25	-0.199	0.070	49

REGRESSION OF MULTIPLICATIVE MODEL

MULTIPLE R..... .751
MULTIPLE R SQUARED..... .564

ANALYSIS OF VARIANCE

SOURCE OF VARIATION	DF	SUMS OF SQUARES	MEAN SQUARES	F-VALUE
INTERCEPT	1	8.111E0001	8.111E0001	
REGRESSION	25	2.527E0001	1.011E0000	8.238
TYPE 1	1	1.266E-001	1.266E-001	1.031
TYPE 2	6	5.390E0000	8.984E-001	7.320
TYPE 3	14	1.626E0001	1.162E0000	9.465
TYPE 4	2	6.883E-001	3.441E-001	2.804
TYPE 5	1	3.833E-001	3.833E-001	3.124
TYPE 6	1	9.969E-001	9.969E-001	8.124
RESIDUALS	159	1.951E0001	1.227E-001	
TOTAL	185	1.259E0002		

Table 6. Scotian Shelf silver hake Canadian July research vessel survey catch numbers ('000) at age.

Age	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991
1	7737	26740	89437	17730	32839	192025	114273	188970	102726	552598	146007	69740	172095	117089	66678
2	27660	23257	152705	55638	84724	293420	108957	70369	172576	84325	266663	89508	63810	125952	84743
3	21421	16266	67003	97253	131420	80348	38209	208723	34402	70625	46095	81458	24151	42329	35293
4	4592	8874	20048	45862	60469	60487	19340	37926	71191	22623	18982	16709	13405	13022	13257
5	1348	6733	11522	10684	6241	32426	10632	11828	21488	13448	6048	14249	4130	4173	6577
6	1278	3046	5055	4525	5127	8257	2882	7942	9445	4235	4168	2502	1868	1169	2456
7	984	1286	2664	2001	2367	3549	876	2860	2667	1622	1199	2338	769	432	402
8	336	502	969	589	794	2535	401	1136	1175	673	672	468	282	227	143
9	283	865	275	385	564	327	337	522	215	376	471	121	129	82	124
1+	65,639	87,569	349,678	234,667	334,545	673,374	295,907	530,276	415,885	750,525	490,305	277,093	280,639	304,475	209,904

Table 7: Stratified mean catch/tow for the Canada-USSR juvenile silver hake survey, core strata (60-78).

Year Class	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991
Stratified Mean catch/tow	579.0	8.8	232.2	43.4	284.8	198.0	102.0	204.8	131.5	187.4	78.6
Standard Error of Mean	64.4	1.2	24.4	7.1	62.2	37.9	23.0	35.3	19.0	24.1	10.4
CV	.11	.14	0.11	0.16	0.22	0.19	0.11	0.17	0.10	0.12	0.05
Number of Sets	77	61	64	71	82	74	105	79	74	68	71
July R/V Age 1 #'s (10^{-6})	192	114	190	103	553	146	70	172	117	67	
Comm. catch Age 1 #'s (10^{-6})	20.2	5.9	59.6	15.0	45.6	6.8	5.1	21.5	6.5	5.7	

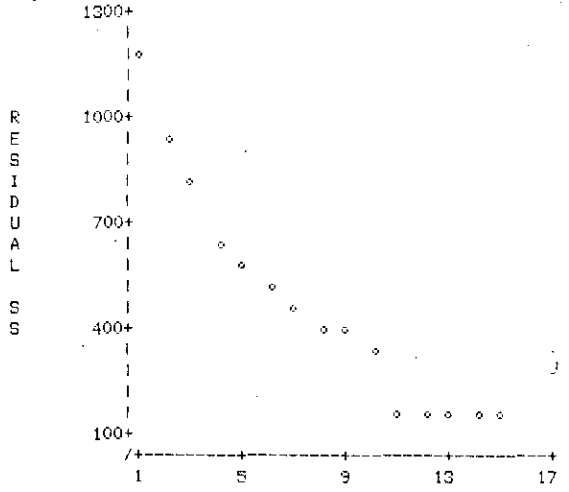
Table 8. Commercial mean weights at age for 4VWX silver hake (kg.)

	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988
1	.065	.074	.076	.040	.061	.066	.067	.070	.068	.053	.045	.045
2	.183	.153	.178	.151	.168	.169	.128	.146	.136	.145	.119	.139
3	.264	.229	.227	.223	.215	.231	.196	.181	.177	.184	.168	.185
4	.340	.266	.274	.287	.276	.275	.239	.224	.210	.250	.211	.227
5	.446	.335	.304	.341	.326	.317	.289	.272	.244	.250	.248	.260
6	.632	.405	.389	.391	.401	.394	.365	.353	.295	.274	.286	.292
7	.886	.438	.455	.531	.553	.446	.395	.405	.410	.392	.453	.401
8	.922	.540	.838	.839	.923	.513	.457	.624	.582	.514	.422	.497
9	2.120	.892	.838	.859	1.137	.506	.444	.650	.669	.644	.518	.688

	1989	1990	1991
1	.060	.063	.047
2	.135	.139	.139
3	.195	.184	.189
4	.224	.218	.215
5	.278	.240	.263
6	.349	.315	.314
7	.403	.370	.471
8	.511	.401	.511
9	.820	.545	.568

Table 9: Output from ADAPT run for 4VWX Silver Hake using the JUVENILE INDEX, RV AND CPUE - AT - AGE. (LOG MODEL FOR AGES 1-8 WITH a DOME=.1.

RUN 8 : 4VWX SILVER HAKE, JUVENILE INDEX, RV AND CPUE - AT - AGE. LOG MODEL FOR AGES 1
4VWX Silver Hake DATED: 1992 6 1 TIME: 10 25
RSS Trajectory by Iteration 4VWX Silver Hake 1992 6 1 10 25 33 110



ITERATION NUMBER

CALIBRATION COEFFICIENTS BY AGE FOR 4VWX Silver Hake 1992 6 1 10 25 33 110

AGE	1 :	I =	0.000 x POP
AGE	2 :	I =	0.000 x POP
AGE	3 :	I =	0.000 x POP
AGE	4 :	I =	0.000 x POP
AGE	5 :	I =	0.000 x POP
AGE	6 :	I =	0.000 x POP
AGE	7 :	I =	0.000 x POP
AGE	8 :	I =	0.000 x POP

MEAN SQUARE RESIDUALS : 0.6559109918
MEAN RESIDUAL : 7.291341442E-7
SUM OF ALL RESIDUALS : 0.000182283536

RUN 8 : 4VWX SILVER HAKE, JUVENILE INDEX, RV AND CPUE - AT - AGE. LOG MODEL FOR AGES 1
4VWX Silver Hake DATED: 1992 6 1 TIME: 10 25

LOG RESIDUALS FOR RV INDEX 1/ 6/92

	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986
1	-1.944	-0.844	0.149	-1.154	-0.827	0.373	0.472	0.505	0.475	1.244
2	-0.796	-0.938	0.764	-0.464	0.225	1.192	-0.357	-0.189	0.313	0.157
3	-0.806	-0.780	0.642	0.730	0.877	0.578	-0.537	0.785	-0.471	0.136
4	-1.413	-1.141	0.245	0.990	0.860	1.004	-0.276	0.176	0.711	0.175
5	-2.236	-0.513	-0.219	0.550	0.654	1.269	0.038	-0.152	0.745	0.132
6	-1.412	-0.965	0.197	-0.472	0.754	0.874	-0.150	0.380	0.494	0.797
7	-1.923	-0.677	-0.238	0.452	-0.377	1.899	-0.395	0.726	0.203	-0.306
8	-2.105	-1.696	0.076	-0.706	0.641	0.635	1.460	0.858	0.858	-0.068

	1987	1988	1989	1990	1991
1	0.701	-0.091	0.364	0.329	0.248
2	0.425	0.059	-0.306	0.009	-0.093
3	0.171	-0.135	-0.546	-0.081	-0.563
4	-0.249	0.059	-0.584	-0.218	-0.338
5	-0.058	0.341	-0.046	-0.481	-0.115
6	-0.095	-0.091	-0.331	0.061	-0.044
7	0.904	0.387	-0.164	-0.427	-0.064
8	-0.220	1.106	-0.241	-0.220	-0.378

SUM OF RV RESIDUALS : 0.000095961198 44 MEAN RESIDUAL : 7.996766536E-7

LOG RESIDUALS FROM EFFORT (or SURVEY) INDEX 1/ 6/92

	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986
1	1.051	0.481	-0.338	0.281	-1.821	0.361	-0.446	1.159	0.207	0.748
2	0.620	0.035	-0.239	-0.415	-1.031	0.033	-0.109	-0.489	-0.007	0.276
3	-0.188	-0.220	-0.214	-0.668	-0.270	0.175	-0.652	-0.015	-0.352	0.654
4	-0.629	-0.782	-0.126	-0.480	-0.575	0.700	-0.389	0.124	0.268	0.769
5	-1.849	-0.635	-0.249	-0.041	-0.363	1.035	-0.168	-0.192	0.419	0.487
6	-1.773	-0.843	0.434	-0.827	-0.108	0.724	0.052	-0.427	0.085	1.311
7	-3.524	-0.197	0.099	0.112	-0.879	1.937	0.113	0.041	0.227	0.093
8	-2.417	-0.456	-0.116	-0.643	0.083	0.005	1.787	-0.330	-0.309	0.441

	1987	1988	1989	1990	1991
1	-0.080	-0.847	0.368	-1.093	-0.708
2	0.783	-0.132	0.254	0.401	0.021
3	0.732	0.272	0.638	0.075	0.034
4	0.454	0.126	0.987	-0.220	-0.228
5	0.615	0.215	1.067	0.020	-0.361
6	0.525	-0.643	1.079	-0.071	-0.119
7	0.465	0.629	0.969	0.292	-0.375
8	-0.562	0.940	1.856	-0.439	0.160

SUM OF RV RESIDUALS : 0.00008396577307 MEAN RESIDUAL : 6.997147756E-7

RESIDUALS FROM JUVINILE INDEX 1/ 6/92

	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986
	-2.663	-1.072	-0.941	1.537	0.257	0.393	1.038	0.139	0.851	0.462

SUM OF CPUE RESIDUALS : 1.954737267 MEAN RESIDUAL : 0.1303158178

ESTIMATED PARAMETERS AND STANDARD ERRORS

Analytical Summary

ORTHOGONALITY OFFSET..... 0.005399

MEAN SQUARE RESIDUALS 0.655911

AGE	PAR. EST.	STD. ERR.	T-STATISTIC	C.V.	BIAS o/o
1	626519.112565	304662.578424	2.056	0.49	12.41
2	678675.826159	241229.162437	2.813	0.36	7.25
3	472240.029571	115131.028648	4.102	0.24	4.23
4	118019.785468	35029.959979	3.226	0.31	6.68
5	33324.907621	11566.018182	2.881	0.35	8.01
6	10338.355693	3677.523086	2.811	0.36	9.21
7	1569.010770	652.229013	2.406	0.42	9.37
8	1150.253321	471.302336	2.441	0.41	8.81
1	0.000011	0.000002	4.672	0.21	1.83
2	0.000020	0.000004	4.719	0.21	1.88
3	0.000026	0.000006	4.720	0.21	2.00
4	0.000032	0.000007	4.690	0.21	2.05
5	0.000040	0.000009	4.679	0.21	1.94
6	0.000047	0.000010	4.650	0.22	1.99
7	0.000041	0.000009	4.663	0.21	1.97
8	0.000026	0.000006	4.686	0.21	1.94
1	0.000001	0.000000	4.673	0.21	1.82
2	0.000009	0.000002	4.724	0.21	1.86
3	0.000028	0.000006	4.732	0.21	1.95
4	0.000035	0.000007	4.709	0.21	1.97
5	0.000034	0.000007	4.699	0.21	1.88
6	0.000028	0.000006	4.674	0.21	1.89
7	0.000015	0.000003	4.676	0.21	1.91
8	0.000007	0.000002	4.693	0.21	1.92
1	0.000080	0.000021	3.774	0.26	2.82

Parameter Correlation Matrix

	1	2	3	4	5	6	7	8	9	10
1	1.000	0.064	0.034	0.024	0.014	0.005	0.004	0.004	-0.163	-0.012
2	0.064	1.000	0.043	0.029	0.017	0.007	0.006	0.005	-0.125	-0.135
3	0.034	0.043	1.000	-0.039	0.010	0.030	0.036	0.048	-0.068	-0.077
4	0.024	0.029	-0.039	1.000	0.027	0.023	0.027	0.036	-0.047	-0.049
5	0.014	0.017	0.010	0.027	1.000	0.036	0.031	0.030	-0.027	-0.028
6	0.005	0.007	0.030	0.023	0.036	1.000	0.054	0.039	-0.011	-0.011
7	0.004	0.006	0.036	0.027	0.031	0.054	1.000	0.056	-0.009	-0.010
8	0.004	0.005	0.048	0.036	0.030	0.039	0.056	1.000	-0.009	-0.010
9	-0.163	-0.125	-0.068	-0.047	-0.027	-0.011	-0.009	-0.009	1.000	0.024
10	-0.012	-0.135	-0.077	-0.049	-0.028	-0.011	-0.010	-0.010	0.024	1.000
11	-0.007	-0.009	-0.129	-0.078	-0.049	-0.018	-0.015	-0.016	0.014	0.016
12	-0.006	-0.007	-0.006	-0.166	-0.098	-0.045	-0.023	-0.020	0.011	0.012
13	-0.004	-0.005	-0.027	-0.020	-0.173	-0.102	-0.061	-0.031	0.008	0.009
14	-0.004	-0.005	-0.047	-0.031	-0.027	-0.190	-0.124	-0.075	0.007	0.008
15	-0.005	-0.006	-0.075	-0.047	-0.035	-0.033	-0.169	-0.128	0.009	0.010
16	-0.006	-0.007	-0.092	-0.070	-0.045	-0.034	-0.022	-0.161	0.012	0.013
17	-0.163	-0.125	-0.068	-0.047	-0.027	-0.011	-0.009	-0.009	0.045	0.024
18	-0.012	-0.130	-0.073	-0.048	-0.028	-0.011	-0.009	-0.009	0.023	0.025
19	-0.006	-0.008	-0.116	-0.070	-0.043	-0.016	-0.014	-0.014	0.013	0.014
20	-0.005	-0.006	-0.004	-0.149	-0.088	-0.037	-0.020	-0.018	0.010	0.011
21	-0.004	-0.005	-0.024	-0.018	-0.158	-0.090	-0.051	-0.028	0.007	0.008
22	-0.003	-0.004	-0.043	-0.028	-0.023	-0.172	-0.112	-0.063	0.007	0.007
23	-0.004	-0.006	-0.068	-0.043	-0.033	-0.031	-0.162	-0.119	0.009	0.010
24	-0.006	-0.007	-0.091	-0.065	-0.043	-0.032	-0.022	-0.156	0.011	0.012
25	-0.196	-0.151	-0.081	-0.056	-0.033	-0.012	-0.010	-0.010	0.055	0.029

	11	12	13	14	15	16	17	18	19	20
1	-0.007	-0.006	-0.004	-0.004	-0.005	-0.006	-0.163	-0.012	-0.006	-0.005
2	-0.009	-0.007	-0.005	-0.005	-0.006	-0.007	-0.125	-0.130	-0.008	-0.006
3	-0.129	-0.006	-0.027	-0.047	-0.075	-0.092	-0.068	-0.073	-0.116	-0.004
4	-0.078	-0.166	-0.020	-0.031	-0.047	-0.070	-0.047	-0.048	-0.070	-0.149
5	-0.049	-0.098	-0.173	-0.027	-0.035	-0.045	-0.027	-0.028	-0.043	-0.088
6	-0.018	-0.045	-0.102	-0.190	-0.033	-0.034	-0.011	-0.011	-0.016	-0.037
7	-0.015	-0.023	-0.061	-0.124	-0.169	-0.022	-0.009	-0.009	-0.014	-0.020
8	-0.016	-0.020	-0.031	-0.075	-0.128	-0.161	-0.009	-0.009	-0.014	-0.018
9	0.014	0.011	0.008	0.007	0.009	0.012	0.045	0.023	0.013	0.010
10	0.016	0.012	0.009	0.008	0.010	0.013	0.024	0.025	0.014	0.011
11	1.000	0.019	0.015	0.013	0.017	0.021	0.014	0.015	0.023	0.017
12	0.019	1.000	0.024	0.017	0.016	0.019	0.011	0.011	0.017	0.034
13	0.015	0.024	1.000	0.031	0.022	0.018	0.008	0.008	0.013	0.021
14	0.013	0.017	0.031	1.000	0.036	0.024	0.007	0.008	0.012	0.015
15	0.017	0.016	0.022	0.036	1.000	0.032	0.009	0.010	0.015	0.014
16	0.021	0.019	0.018	0.024	0.032	1.000	0.012	0.012	0.019	0.017
17	0.014	0.011	0.008	0.007	0.009	0.012	1.000	0.023	0.013	0.010
18	0.015	0.011	0.008	0.008	0.010	0.012	0.023	1.000	0.013	0.010
19	0.023	0.017	0.013	0.012	0.015	0.019	0.013	0.013	1.000	0.015
20	0.017	0.034	0.021	0.015	0.014	0.017	0.010	0.010	0.015	1.000
21	0.013	0.022	0.038	0.027	0.019	0.016	0.007	0.008	0.012	0.019
22	0.012	0.015	0.028	0.049	0.032	0.021	0.007	0.007	0.011	0.013
23	0.016	0.015	0.020	0.034	0.046	0.030	0.009	0.009	0.014	0.013
24	0.020	0.018	0.017	0.023	0.031	0.038	0.011	0.012	0.018	0.016
25	0.017	0.014	0.010	0.008	0.011	0.014	0.055	0.028	0.015	0.012

	21	22	23	24	25
1	-0.004	-0.003	-0.004	-0.006	-0.196
2	-0.005	-0.004	-0.006	-0.007	-0.151
3	-0.024	-0.043	-0.068	-0.091	-0.081
4	-0.018	-0.028	-0.043	-0.065	-0.056
5	-0.158	-0.023	-0.033	-0.043	-0.033
6	-0.090	-0.172	-0.031	-0.032	-0.012
7	-0.051	-0.112	-0.162	-0.022	-0.010
8	-0.028	-0.063	-0.119	-0.156	-0.010
9	0.007	0.007	0.009	0.011	0.055
10	0.008	0.007	0.010	0.012	0.029
11	0.013	0.012	0.016	0.020	0.017
12	0.022	0.015	0.015	0.018	0.014
13	0.038	0.028	0.020	0.017	0.010
14	0.027	0.049	0.034	0.023	0.008
15	0.019	0.032	0.046	0.031	0.011
16	0.016	0.021	0.030	0.038	0.014
17	0.007	0.007	0.009	0.011	0.055
18	0.008	0.007	0.009	0.012	0.028
19	0.012	0.011	0.014	0.018	0.015
20	0.019	0.013	0.013	0.016	0.012
21	1.000	0.024	0.018	0.015	0.009
22	0.024	1.000	0.030	0.020	0.008
23	0.018	0.030	1.000	0.029	0.010
24	0.015	0.020	0.029	1.000	0.013
25	0.009	0.008	0.010	0.013	1.000

Table 10a: SILVER HAKE POPULATION NUMBERS ('000S)

	1977	1978	1979	1980	1981	1982	1983	1984
1	655079	753493	929605	679649	893189	1584697	850999	1397003
2	438217	424448	487937	606292	442001	596792	1045724	565653
3	276196	234364	226957	279675	348529	275638	356668	621674
4	85464	136129	91440	92456	129841	144356	122644	193103
5	40966	44950	62574	31272	35750	56273	40763	58237
6	14754	25644	19726	23621	9120	14198	11724	18001
7	20986	9296	12910	5060	11589	3465	4650	5079
8	13290	13988	4671	6060	2220	6785	651	2446
9	190	8835	8421	2726	3693	1251	4168	229
1+	1545142	1651147	1844241	1726812	1875931	2683455	2437991	2861425
2+	890063	897654	914635	1047163	982742	1098758	1586993	1464422
3+	451846	473206	426698	440870	540741	501967	541269	898769
4+	175651	238842	199741	161195	192213	226328	184601	277095

	1985	1986	1987	1988	1989	1990	1991
1	769273	1923227	865031	910925	1436968	1004915	622129
2	887652	503403	1251845	574277	606428	943363	668896
3	341648	487910	279910	663736	333541	336216	457969
4	247325	148494	139463	93953	227701	93610	109738
5	61559	60691	30686	49100	30850	33830	32469
6	23200	13337	17237	9874	15472	4284	10060
7	8572	7915	1768	6606	4075	2700	1545
8	2555	3827	4130	901	2682	1447	1135
9	1490	1527	2158	2641	433	843	871
1+	2343273	3150330	2592228	2312012	2658149	2421209	1904812
2+	1574000	1227103	1727197	1401088	1221181	1416293	1282683
3+	686348	723700	475352	826811	614753	472931	613787
4+	344700	235791	195442	163074	281212	136715	155817

Table 10b: Silver hake population biomass (tons)

	1977	1978	1979	1980	1981	1982	1983	1984	1985
1	42580	55985	70650	26982	54127	104115	57187	97930	52387
2	80194	64856	86950	91671	74035	100858	134166	82585	120898
3	72778	53576	51474	62312	74969	63617	69764	112461	60540
4	29032	36210	25027	26498	35862	39698	29324	43332	51988
5	18275	15063	19041	10664	11640	17855	11768	15864	14996
6	9323	10383	7671	9229	3658	5588	4277	6349	6846
7	18602	4071	5874	2689	6408	1545	1835	2058	3514
8	12256	7551	3915	5087	2049	3479	298	1525	1486
9	403	7880	7055	2342	4199	633	1850	149	997
1+	283443	255573	277658	237474	266946	337388	310470	362253	313652
2+	240863	199589	207008	210491	212819	233274	253283	264323	261265
3+	160669	134733	120057	118820	138784	132416	119116	181737	140366
4+	87891	81158	68584	56508	63815	68799	49352	69277	79826

	1986	1987	1988	1989	1990	1991
1	102508	38580	41174	86505	63611	24699
2	73144	148970	79939	82110	131316	89431
3	89922	47025	122592	64874	61796	85457
4	37138	29371	21290	51005	20360	23144
5	15179	7619	12786	8579	8113	8471
6	3652	4930	2885	5403	1348	2962
7	3102	801	2646	1642	998	705
8	1968	1742	447	1369	580	559
9	984	1118	1817	355	459	480
1+	327596	280156	285576	301843	288582	235907
2+	225088	241576	244402	215338	224971	211209
3+	151944	92606	164462	133228	93655	121777
4+	62022	45581	41870	68354	31858	36320

Table 10c. Silver hake Fishing Mortality

	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988
1	0.034	0.035	0.027	0.030	0.003	0.016	0.008	0.054	0.024	0.029	0.010	0.007
2	0.226	0.226	0.157	0.154	0.072	0.115	0.120	0.104	0.198	0.187	0.234	0.143
3	0.308	0.541	0.498	0.367	0.481	0.410	0.214	0.522	0.433	0.852	0.692	0.670
4	0.243	0.377	0.673	0.550	0.436	0.865	0.345	0.743	1.005	1.177	0.644	0.714
5	0.068	0.424	0.574	0.832	0.523	1.169	0.417	0.520	1.129	0.859	0.734	0.755
6	0.062	0.286	0.961	0.312	0.568	0.716	0.437	0.342	0.675	1.621	0.559	0.485
7	0.006	0.288	0.356	0.424	0.139	1.272	0.242	0.287	0.407	0.250	0.274	0.501
8	0.008	0.108	0.139	0.095	0.174	0.087	0.644	0.096	0.114	0.173	0.047	0.332
9	0.027	0.047	0.055	0.045	0.047	0.064	0.026	0.057	0.072	0.092	0.068	0.068

	1989	1990	1991
1	0.021	0.007	0.011
2	0.190	0.323	0.237
3	0.871	0.720	0.735
4	1.507	0.659	0.696
5	1.574	0.813	0.590
6	1.346	0.620	0.629
7	0.635	0.467	0.256
8	0.757	0.108	0.213
9	0.115	0.071	0.072

POPULATION NUMBERS

	1991	1992	1993	1994
1	544923	910925	960883	960883
2	620401	360608	595733	628071
3	438597	321275	204825	337172
4	102408	134459	106429	66830
5	29868	31833	44542	34726
6	9133	10348	10545	14533
7	1400	2981	4057	4087
8	1035	705	1528	2067
9	871	548	428	925
1+	1748636	1773683	1928970	2049293
2+	1203713	862758	968087	1088410
3+	583312	502150	372354	460340
4+	144715	180874	167529	123168

MID+YEAR POPULATION BIOMASS (AVERAGE)

	1991	1992	1993	1994
1	25447	42306	44615	44615
2	62274	37732	62233	65611
3	46817	35392	22424	36913
4	13530	18230	14341	9005
5	4770	4990	6940	5410
6	1693	2069	2099	2892
7	416	894	1213	1222
8	402	291	631	853
9	462	293	228	494
1+	155810	142197	154723	167016
2+	130363	99891	110108	122401
3+	68089	62160	47875	56790
4+	21272	26768	25451	19877

BEGINNING OF THE YEAR POPULATION BIOMASS (TONS)

	1991	1992	1993	1994
1	31061	51923	54770	54770
2	84995	49403	81615	86046
3	79825	58472	37278	61365
4	22939	30119	23840	14970
5	7736	8245	11536	8994
6	2813	3187	3248	4476
7	575	1225	1667	1680
8	543	370	802	1085
9	579	364	285	615
1+	231067	203309	215042	234002
2+	200006	151386	160272	179231
3+	115011	101983	78657	93186
4+	35186	43511	41378	31820

CATCH BIOMASS

	1991	1992	1993	1994
1	327	1044	1124	1124
2	16071	6250	10530	11101
3	36626	24945	16145	26578
4	10397	12849	10325	6484
5	3148	3517	4996	3895
6	1218	1110	1150	1585
7	119	240	333	335
8	95	29	64	87
9	33	16	13	28
1+	68034	50000	44681	51216
2+	67707	48956	43556	50092
3+	51636	42707	33027	38991
4+	15010	17762	16881	12413

MEAN WEIGHT OF INDIVIDUALS IN CATCH

	1991	1992	1993	1994
	.2	.2	.2	.2

FISHING MORTALITY 4/ 6/92

	1991	1992	1993	1994
1	.013	.025	.025	.025
2	.258	.166	.169	.169
3	.782	.705	.720	.720
4	.768	.705	.720	.720
5	.660	.705	.720	.720
6	.720	.536	.548	.548
7	.286	.269	.274	.274
8	.236	.099	.102	.102
9	.072	.055	.056	.056
1+	.352	.244	.201	.222

PRODUCTION

SOURCE	1991	1992	1993	1994
RECRUITMENT BIOMASS	20035	33492	35328	35328
GROWTH	76753	74188	86522	91475
TOTAL PRODUCTION	96788	107680	121850	126804
LOSS THROUGH FISHING	68034	50000	44681	51216
SURPLUS PRODUCTION	34464	50801	59961	59997
NET PRODUCTION	33570	801	15280	8781

PRODUCTION/BIOMASS RATIO 4/ 6/92

	1991	1992	1993	1994
	.62	.76	.79	.76

SUMMARY OF PROJECTIONS

YEAR	1991	1992	1993	1994
POPULATION NUMBERS	1748636.19	1773682.81	1928969.82	2049293.43
POPULATION BIOMASS	155809.86	142197.32	154722.76	167015.80
CATCH	68034.00	50000.00	44680.64	51216.39
F OR QUOTA	68034.00	50000.00	.72	.72

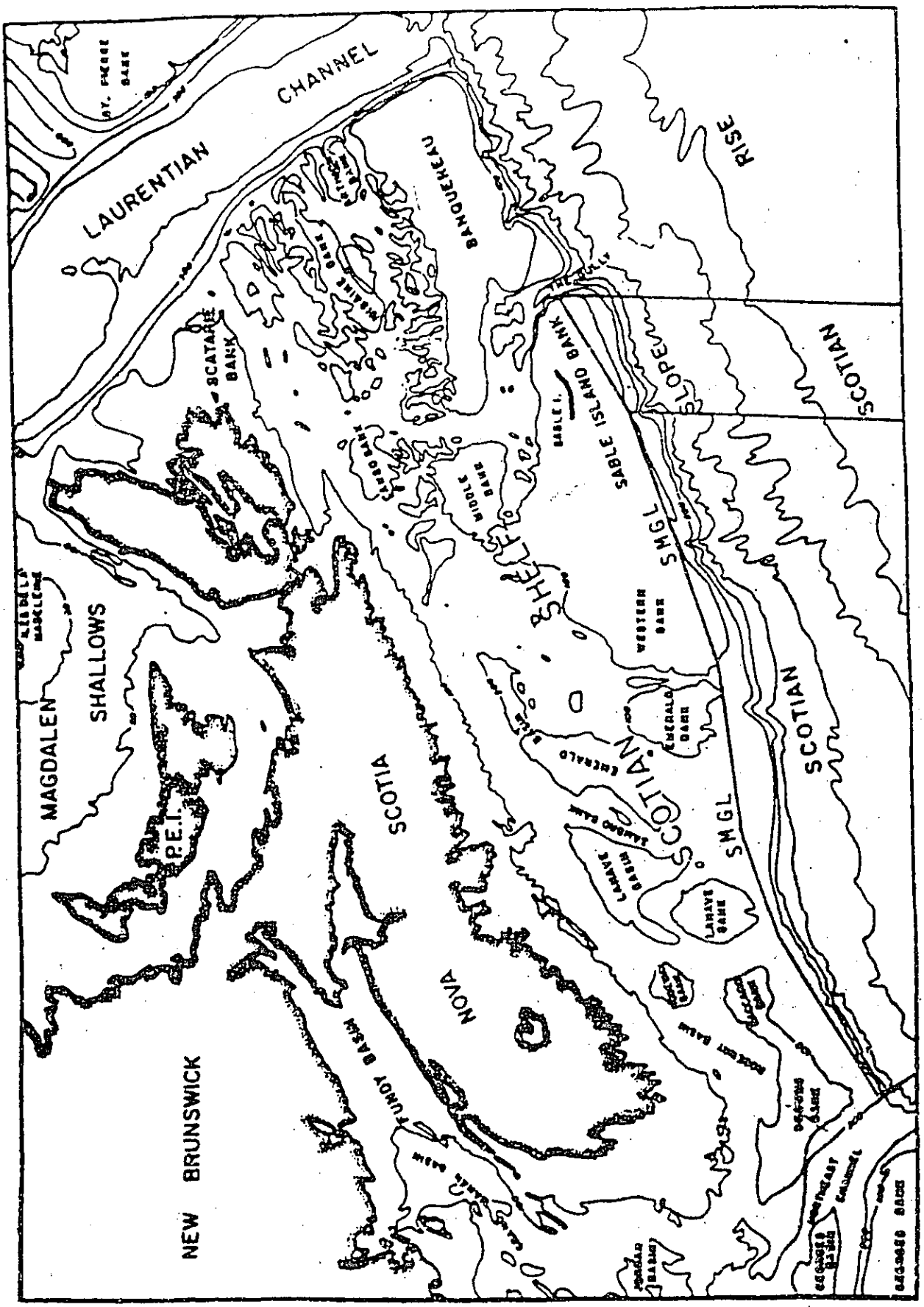


Figure 1 Bathymetric map of the Scotian Shelf and the Bay of Fundy showing the Small Heah Gear Line (SMGL)

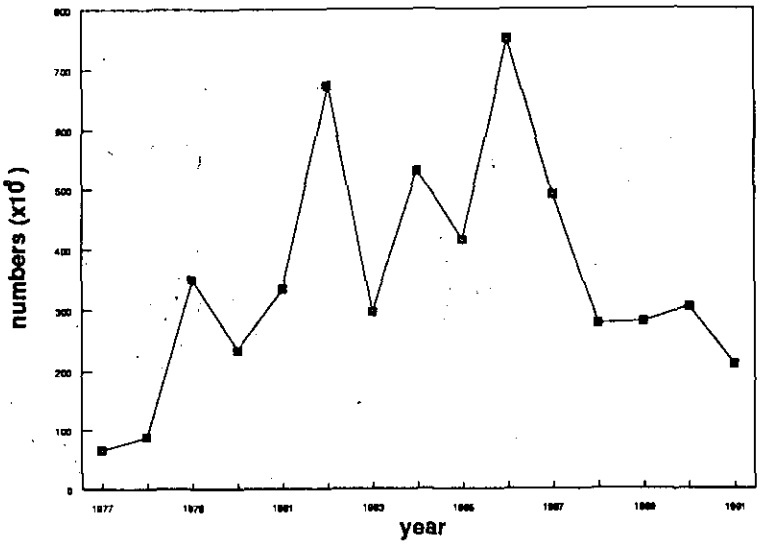


Figure 2. July RV survey silver hake 1+ numbers.

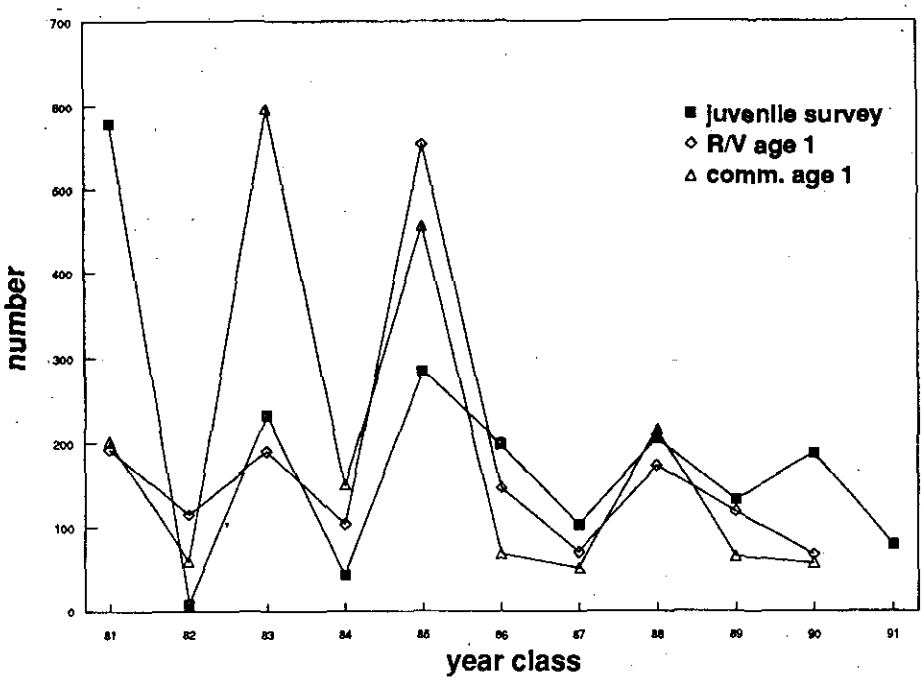
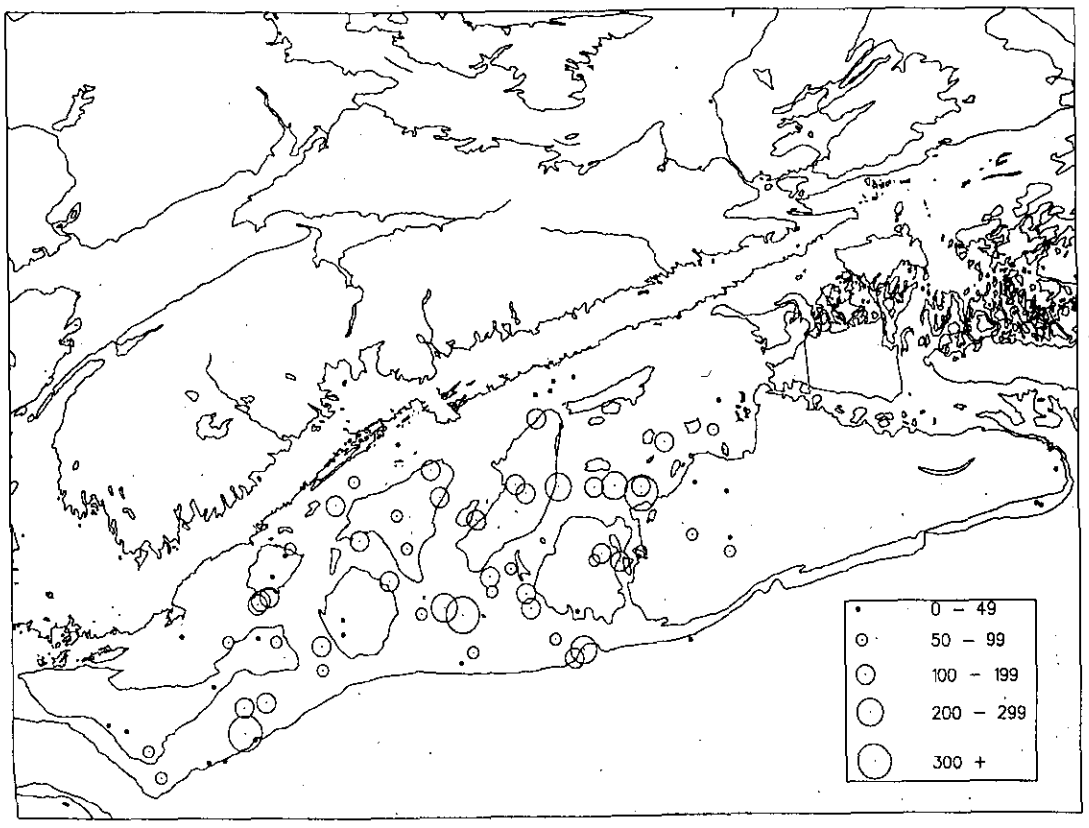


Figure 3. Comparison of juvenile silver hake survey with July RV survey and commercial catch age 1 numbers.

Figure 4. Distribution of silver hake catches during the fall 1991 juvenile silver hake survey



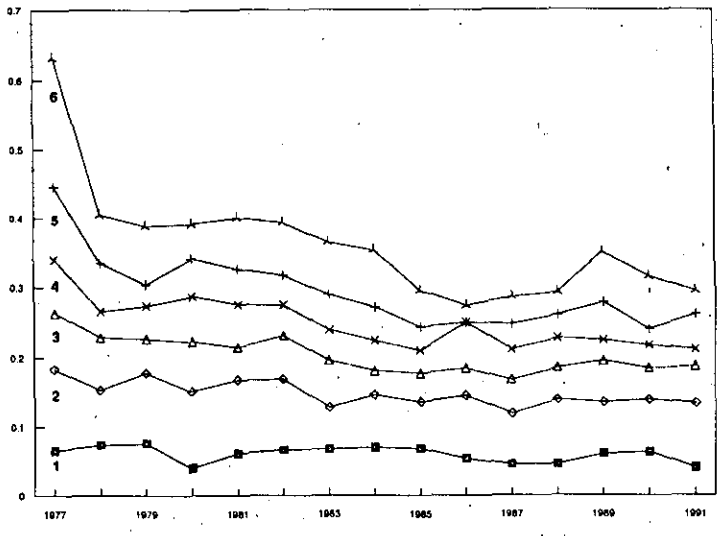


Figure 5: Mean weight at age for 4VWX Silver hake, 1977-1991.