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An Assessment of the Scotian Shelf Silver Hake
(*Merluccius bilinearis*) Population for 1980

by

D. E. Waldron
Marine Fish Division
Bedford Institute of Oceanography
Dartmouth, N. S., Canada B2Y 4A2

INTRODUCTION

SILVER HAKE (*MERLUCCIIUS BILINEARIS*) BELONGS TO THE GADIDAE FAMILY WHICH ALSO INCLUDES THE COMMON COD, HADDOCK, AND POLLOCK. SPECIES DISTRIBUTION RANGES FROM THE GRAND BANKS TO DELAWARE (LIEM AND SCOTT, 1966). TWO STOCKS SOUTH OF BROWN'S BANK HAVE BEEN REFERRED TO BY ANDERSON (1977). ALTHOUGH THERE IS NO SPECIFIC DELINEATION OF A THIRD STOCK SILVER HAKE ON THE SCOTIAN SHELF HAVE BEEN HISTORICALLY REGARDED AS A DISTINCT UNIT (HALLIDAY ET AL., 1978). A DISTINCT SCOTIAN SHELF SPANNING CONCENTRATION WAS OBSERVED AS EARLY AS 1962 BY RESEARCH VESSELS FROM THE USSR [SARNITS AND SAUSKIN, 1967]. SAUSKIN (1964) ALSO SUPPORTS THE THEORY OF A SEPERATE SCOTIAN SHELF STOCK.

SARNITS AND SAUSKIN (1967) IDENTIFIED SEASONAL AREAS OF SILVER HAKE STOCK CONCENTRATIONS AS THE SHELF BREAK AND SABLE ISLAND BANK. CLAY (1979) SUMMARIZED 1961 TO 1968 USSR SCOUTING VESSEL DATA WHICH DESCRIBED MONTHLY CONCENTRATIONS OF SILVER HAKE FROM MAY TO JULY IN AN AREA SEAWARD OF THE SMALL MESH GEAR LINE. RECENTLY SCOTT (1967 AND 1980) PRESENTED RESULTS FROM CANADIAN RESEARCH VESSEL SURVEYS WHICH SHOW THAT BOTH ADULTS AND JUVENILES (AGE 1) FISH ARE HIGHLY CONCENTRATED ON EMERALD BANK AND THE SLOPE BREAK.

SPAWNING OCCURS OVER THE SCOTIAN SHELF FROM MAY TO OCTOBER PEAKING IN JUNE AND AUGUST (SARNITS AND SAUSKIN, 1967); MOSKOV, 1976, AND MOSKOV ET AL, 1978). SAUSKIN (1968) SUGGESTS THAT SILVER HAKE FEMALES ARE SEQUENTIAL SPAWNERS WITH ONE FEMALE SPAWNING AT LEAST TWICE. HICKLING AND RUTENBERG (1971) SUPPORT THIS HYPOTHESIS WITH OVSERVATIONS ON MERLUCCIIUS MERLUCCIIUS.

SILVER HAKE HAVE BEEN OBSERVED AT AGES TO 12 YEARS. AT THIS AGE THEY HAVE AN AVERAGE WEIGHT AND LENGTH OF 1.4KG AND 67CM RESPECTIVELY. THE MAXIMUM POSSIBLE LENGTH (L_{∞}) HAS BEEN CALCULATED AT 94CM WHICH SUGGEST THE TERMINAL AGE TO BE 20 YEARS.

RECORDS OF A SCOTIAN SHELF COMMERCIAL FISHERIES FOR SILVER HAKE DATE BACK TO THE EARLY 1950'S (CLAY, 1979). THE INTRODUCTION OF THE SOVIET FLEET IN 1962 SIGNALLED THE START OF A TRULY DIRECTED FISHERY. PEAK CATCHES OCCURRED IN 1963 (123,000T), 1970 (169,000T) AND THE LARGEST IN 1973 (300,000T). RECENT CATCHES HAVE REMAINED NEAR 50,000 TONS (FIGURE 1). ALTHOUGH ALLOCATIONS HAVE NOT ALWAYS BEEN CAUGHT, THE USSR HAS BEEN ABLE TO CATCH THE MAJOR PORTION OF THEIR ALLOCATION.

WHEN CANADA PROCLAIMED A 200 MILE MANAGEMENT ZONE, FOREIGN FLEETS WERE RESTRICTED TO THE EASWARDSIDE OF WHAT IS NOW REFERRED TO AS THE SMALL MESH GEAR LINE (SMGL). SINCE 1977, A LARGE BODY OF DATA HAS BEEN COLLECTED ON CATCH, EFFORT AND MORPHOLOGICAL DATA BY TRAINED OBSERVERS. THIS INFORMATION HAS BEEN AND IS USED TO EVALUATE THE SILVER HAKE STOCK.

CATCH AND EFFORT

PROVISIONAL 1980 CATCHES WERE OBTAINED FROM CIRCULAR LETTERS, CANADA AND NAFO (TABLE 1); DIRECTED SILVER HAKE EFFORT FOR 1980 WAS ESTIMATED FROM THE OBSERVED DIRECTED CPUE FOR EACH FLEET (TABLE 2), DIRECTED CATCH AND EFFORT FOR 1979 WAS OBTAINED FROM NAFO AND WAS ADJUSTED BY TONNAGE CLASS AND GEAR TO USSR OTB₂, TONNAGE CLASS 7 VESSELS FISHING FOR SILVER HAKE, EFFORT FOR PREVIOUS YEARS WAS OBTAINED FROM CLAY AND BEANLAND (1980) WHO ADJUSTED REPORTED EFFORT TO THE USSR OTB₂, TO DIRECTED SILVER HAKE FISHERY (IE, WHEN SILVER HAKE WAS THE MAJOR SPECIES CAUGHT),

1980 SAMPLING INTENSITY

SAMPLING FOR CATCH, EFFORT, LENGTH AND AGE WAS CONDUCTED BY THE CANADA MARITIMES OBSERVERS, FROM THE APPROXIMATELY 44,000 TONS OF SILVER HAKE REPORTED CAUGHT 25,000 TONS, OR 57 PERCENT, WAS OBSERVED FOR ALL FLEETS, COVERAGE LEVELS IN 1978 AND 1979 ARE GIVEN IN TABLE 3, DETAILED 1980 OBSERVED CATCH AND EFFORT ARE CONTAINED IN APPENDIX 1;

SAMPLING LEVELS FOR LENGTHS WERE ABOVE THE NAFO RECOMMENDED LEVELS FOR ALL MONTHS (TABLE 4), OTOLITH SAMPLES WERE ADEQUATE FOR ALL MONTHS EXCEPT SEPTEMBER WHEN ONLY 20 PAIRS WERE TAKEN

RESEARCH VESSEL SURVEYS

MINIMUM ESTIMATES FROM JULY-AUGUST CANADIAN RESEARCH SURVEYS ON THE SCOTIAN SHELF ARE REPORTED IN DETAIL IN APPENDIX 2; THE DESIGN AND SAMPLING METHODOLOGIES OF THESE CRUISES ARE DISCUSSED IN HALIDAY (1974), ALTHOUGH BIOMASS ESTIMATES ARE AVAILABLE (DOUBLEDAY AND HUNT, 1976), AGEING HAS NOT BEEN COMPLETED FOR THE 1970 AND 1971, RESEARCH VESSEL CATCH NUMBERS AT AGE FOR 1972 TO 1980 ARE SUMMARIZED IN TABLES 5 AND 6, -

RESEARCH NUMBERS PEAKED TO 228,000 THOUSANDS IN 1973 (FIGURE 2), SINCE THAT TIME THE ESTIMATED NUMBERS HAVE FLUCTUATED UNTIL 1978 THROUGH TO 1980 WHERE THEY WERE IN THE RANGE OF 43,000 TO 48,000 THOUSANDS, BIOMASS TRENDS FOLLOWED NUMBERS UNTIL 1980 WHEN THE BIOMASS INCREASED WHILE RESEARCH NUMBERS DECREASED (FIGURE 3), THIS CAN BE ACCOUNTED FOR BY THE PRESENCE OF THE ABOVE AVERAGE 1976 YEAR CLASS COUPLED WITH LARGER MEAN WEIGHT-AT-AGE FOR 1980,

CATCH AT AGE

LENGTH FREQUENCY DATA COLLECTED BY THE OBSERVER PROGRAM IN 1980 WAS SUMMARIZED BY MONTH AND SEX FOR EACH COUNTRY SAMPLED, THESE MONTHLY SUMMARIES WERE ADJUSTED TO THE ESTIMATED MONTHLY REMOVALS (TABLE 1) USING MONTHLY AGE-LENGTH KEYS SUPPLIED BY THE AGEING GROUP IN ST. ANDREWS, EXCEPT FOR SEPTEMBER, MONTHLY NUMBERS-AT-AGE FOR EACH SEX WERE CALCULATED BY MULTIPLYING THE MATRIX OF PERCENT AGE-AT-LENGTH BY THE NUMBERS-AT-LENGTH VECTOR, REMOVALS-AT-AGE FOR SEPTEMBER WERE DERIVED FROM THE AUGUST AGE-LENGTH KEY, THE SUM OF THESE MONTHLY PRODUCTS FOR EACH COUNTRY WERE ADJUSTED TO TOTAL CATCH IN ORDER TO ARRIVE AT THE ESTIMATED REMOVALS-AT-AGE FOR 1980 (TABLE 7),

REMOVALS-AT-AGE FOR 1961 TO 1978 WERE DERIVED BY CLAY AND BEANLANDS (1980), THE 1979 REMOVALS-AT-AGE PRESENTED BY CLAY AND BEANLANDS (1980) WERE BASED ON A 51,000T CATCH, THESE WERE ADJUSTED UPWARDS WITH THE FINAL 1979 CATCH OF 56,000 TONS,

MEAN WEIGHTS-AT-AGE

MEAN WEIGHTS-AT-AGE FOR 1961 TO 1979 WERE DERIVED BY CLAY AND BEANLANDS (1980), THE 1980 MEAN WEIGHT-AT-AGE WERE COMPUTED USING THE JULY, 1980 RESEARCH VESSEL WEIGHT LENGTH RELATIONSHIP

FOR EACH SEX APPLIED TO MONTHLY COMMERCIAL MEAN LENGTHS FOR EACH SEX, THE YEARLY AVERAGE MEAN WEIGHTS-AT-AGE WAS CALCULATED BY SUMMING THE PRODUCT OF THE MONTHLY NUMBER OF FISH AT AGE FOR EACH SEX TIMES THE MONTHLY MEAN WEIGHT-AT-AGE FOR EACH SEX THEN DIVIDING BY THE YEARLY NUMBER OF FISH AT-AGE FOR ALL SEXES COMBINED (TABLE 8),
MEAN WEIGHTS FOR PROJECTION WERE AVERAGED FROM 1977-1980

AGE	1	2	3	4	5	6	7	8	9	10
1979 WT AT AGE	0.061	0.154	0.200	0.245	0.285	0.344	0.411	0.520	0.553	1.189
1980 WT AT AGE	0.041	0.141	0.213	0.280	0.322	0.366	0.520	0.601	0.892	1.452
AVE 1977 - 1980	0.053	0.138	0.199	0.260	0.322	0.389	0.495	0.674	0.829	0.825

CATCH BIOMASS-AT-AGE WAS CALCULATED BY MULTIPLYING THE REMOVALS-AT-AGE BY THE MEAN WEIGHTS-AT-AGE (TABLE 9), AGREEMENT BETWEEN REPORTED NOMINAL CATCH AND CALCULATED 1+ BIOMASS WAS GOOD CONSIDERING POSSIBLE SAMPLING ERRORS FOR THE MEAN WEIGHTS-AT-AGE AND SMALL ERRORS IN CALCULATING NOMINAL CATCH, SUCH AS CONVERSION FACTORS CURRENTLY USED,

YEARS	1963	1964	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980
CATCH	123028	81147	50022	10323	2477	3471	46323	169045	128657	114048	298621	95745	116286	97184	35762	48200	56391	44373
EST	122726	81426	50051	10401	2516	3562	46598	169663	127698	113188	298933	95598	116562	97243	36833	48176	56402	44726
DIFF.	302	-279	-29	-78	-39	-91	-275	-618	959	860	-312	147	-276	-59	-1071	24	-11	-353

NATURAL MORTALITY AND CPUE-AT-AGE

THE SAME $M(0,4)$ AS USED IN THE PREVIOUS ASSESSMENT WAS DERIVED BY TERRE AND HARI (1977), A CPUE-AT-AGE MATRIX WAS CALCULATED BY DIVIDING THE CATCH REMOVALS-AT-AGE (NUMBERS) BY THE APPROPRIATE YEARLY EFFORT (TABLE 10), PALOHEIMO Z VALUES WERE CALCULATED ($Z = -\ln[(C/F)^2 - (C/F)]$) AND $F = F_1 \times F_2 / 2$ AND REGRESSED AGAINST MEAN EFFORT, THE INTERCEPT (M) AND SLOPE (?) WERE UNREALISTIC AND THE ORIGINAL ESTIMATE OF $M=0,4$ WAS USED FOR THIS ANALYSIS,

VIRTUAL POPULATION ANALYSIS(VFA)AND PARTIAL RECRUITMENT

PARTIAL RECRUITMENT AND F AT AGE 10 USED IN THE PREVIOUS ASSESSMENT WERE INITIALLY EMPLOYED FOR 1980, THESE WERE IMPROVED BY AVERAGING F VALUES OVER THE PERIOD 1977 TO 1979 INORDER TO REFLECT RECENT CHANGES IN MESH SIZE REGULATIONS,

USING THESE PARTIAL RECRUITMENT VALUES, F AT AGE 10 WAS CALCULATED BY AVERAGING F'S FROM AGES 2 TO 6 FOR ALL YEARS EXCEPT 1980, THESE CALCULATED VALUES WERE SUBSTITUTED INTO THE NEXT ITERATION AND THE PROCESS CONTINUED UNTIL NO CHANGE IN F'S WERE NOTED ,

COMPARISON OF WEIGHTED F AGAINST EFFORT AND CPUE AGAINST 2+ POP BIOMASS INDICATED THAT A TERMINAL F OF 0,25 AT $M=0,40$ GAVE THE BEST COMBINATION OF R AND DIFFERENCE BETWEEN THE OBSERVED AND PREDICTED VALUES, POPULATIO NUMBERS,BIOMASS (POPULATION NUMBERS x MEAN WEIGHT-AT-AGE) AND F AT TERMINAL $F=0,25$ ARE PRESENTED IN TABLES 11, 12, 13, BOTH NUMBERS AND BIOMASS FOR 2+ AND 3+ AGED FISH HAVE INCREASED SINCE 1976 AND PROBABLY REFLECT THE SHIFT IN MESH SIZE FROM 40MM TO 60MM CODENDS, ESTIMATED MEAN POPULATION 2+ BIOMASS HAS INCREASED IN 1980 TO LEVELS REMINICENT OF THE BIOMASS PRESENT DURING THE 1973 FISHERY,

THE FINAL PARTIAL RECRUITMENT FOR 1980 WAS DERIVED BY AVERAGING THE 1977 TO 1979 F'S AT AGE (FIGURE 4), FULL RECRUITMENT OCCURS AT AGE 3 WHICH IS ONE YEAR LATER THAN THE AVERAGE OF F'S -AT-AGE PRIOR TO 1977 (FIGURE 5), THERE IS NO EVIDENCE TO SUPPORT CLAY AND BEANLAND'S (1980) PARTIAL RECRUITMENT,

PARTIAL RECRUITMENT USED IN THIS AND PREVIOUS ASSESSMENTS

AGE	1	2	3	4	5	6	7	8	9	10
PR(PREVIOUS)	0.035	0.500	1.000	0.700	0.600	0.600	0.550	0.500	0.450	0.400
PR(1977-180)	0.044	0.444	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
PR(1961-76)	0.109	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000

VALIDATION OF VFA

THE FISHING MORTALITY AT AGES 2 TO 6 WERE WEIGHTED BY POPULATION NUMBERS AND AVERAGED FOR THE YEARS 1966 TO 1980. THE PERIOD 1961 TO 1965 WERE OMITTED FROM THE CALCULATIONS BECAUSE THE FISHERY WAS NEW AND ALSO DURING THE YEARS 1964 AND 1965 THERE WAS A LARGE USSR HADDOCK FISHERY WHICH COULD MASK SOME OF THE EFFORT DIRECTED TOWARDS SILVER HAKE,

REGRESSING WEIGHTED FISHING MORTALITY AGAINST DIRECTED EFFORT ($R=0.930$) AND DIRECTED CPUE (BIOMASS) AGAINST 2+ POPULATION BIOMASS ($R=0.827$) WAS OPTIMIZED WITH A TERMINAL F OF 0.25 (TABLE 14, FIGURES 6 AND 7).

YIELD PER RECRUIT

THE YIELD PER RECRUIT WAS CALCULATED USING THE THOMPSON AND BELL MODEL. MEAN WEIGHTS-AT-AGE WERE AVERAGED FOR THE YEARS 1977-1980. FULLY RECRUITED $F_{0.1}$ WAS 0.447 WITH A YIELD OF 0.062 KG. THE F_{MAX} IS 2.638 WITH A YIELD OF 0.075 KG. (TABLE 15).

RECRUITMENT

RECRUITMENT FOR SILVER HAKE HAS BEEN RELATIVELY STABLE SINCE 1976 AVERAGING 1.07×10^9 INDIVIDUALS. FOR PROJECTION PURPOSES RECRUITMENT WAS AVERAGED FROM 1970 TO 1979 (1.39×10^9) AND AS A RESULT IS POSSIBLY AN OVERESTIMATE OF THE 1980 RECRUITMENT. POPULATION ESTIMATES OF SQUID ABUNDANCE ARE NOT RELIABLE AND AS A RESULT THEIR USE TO PREDICT SILVER HAKE RECRUITMENT IS NOT ADVISABLE AT THIS TIME.

CATCH PROJECTION

CATCH PROJECTIONS UNTIL 1982 WERE CALCULATED USING THE ABOVE PARTIAL RECRUITMENT, $F_{0.1}$, MEAN WEIGHTS-AT-AGE AND THE GEOMETRIC MEAN OF RECRUITMENT FROM 1970 TO 1980 (1.39×10^9 FISH). THREE OPTIONS FOR THE 1982 CATCH WERE GENERATED. THE FIRST ASSUMED THE $F_{0.1}$ CATCH OF 73,000 TONS IN 1981 WOULD PREDICT AN $F_{0.1}$ CATCH IN 1982 OF 68,400 TONS (OPTION 1, TABLE 16). THE SECOND ASSUMED THE ASSIGNED 1981 TAC OF 80,000 TONS WOULD BE CAUGHT. THIS ASSUMPTION PREDICTED THE 1982 CATCH WOULD BE 66,000 TONS (OPTION 2, TABLE 16). THE THIRD ASSUMES THE 1974 - 1979 AVERAGE CATCH/TAC RATIO (.82) OF THE 1981 TAC WOULD BE CAUGHT IN 1981 (OPTION 3, TABLE 16). THE ESTIMATED 1981 CATCH OF 66,000 TONS DECREASED THE 1982 $F_{0.1}$ PREDICTED CATCH FROM 68,000 (OPTION 1) TO 71,000 TONS (OPTION 2).

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Table 1. 1980 Provisional Catch (t) Statistics from Circular Letters, FLASH Statistics¹ and Statistics Branch².

COUNTRY	APRIL	MAY	JUNE	JULY	AUG.	SEPT.	OCT.	NOV.	TOTAL	ALLOC.
Bulgaria ²	-	26	228	388	27	-	-	-	669	1200
Cuba ³	27	560	561	962	165	12	-	-	2287	11200
Canada (Mar.)	-	-	-	-	-	-	-	-	104	20000
Japan ³	-	-	-	1	76	71	54	37	239	-
Portugal ¹	-	-	-	2	2	8	30	5	56	-
Spain ¹	-	-	1	6	10	13	6	1	36	-
USSR ⁴	1346	9442	12670	12891	4518	105	-	10	40982	56600
Total	1373	10028	13460	14250	4798	209	90	53	44373	90000 ⁵

¹ FLASH data only.

² Adjusted to revised total of 669 tons from reported 871 tons.

³ FLASH monthly catch adjusted to NAFO yearly provisional catch.

⁴ Combination of Circ. Letter (APR-JUL) and FLASH (AUG-NOV) adjusted by NAFO provisional catch.

⁵ Includes 900 tons to USA, 100 tons to France (St. Pierre) and 100 tons to EEC.

Table 2. Catch, directed effort and CPUE for silver hake caught in NAFO Divisions 4V, 4W and 4X for all countries.

Year	Nominal Catch ('000 t)	Directed Effort ¹ (Hrs)	CPUE ¹ (Directed)	Observed ² CPUE	Observed ² Catch ('000 t)	Recalculated ⁹ Effort
1963	123	55216	2.22	-	-	55216
64	81	38675	2.11	-	-	38675
1965	50	44696	1.12	-	-	44696
66	11	44175	.24	-	-	44175
67	3	3818	.66	-	-	3818
68	3	19295	.19	-	-	19295
69	47	36033	1.29	-	-	36033
1970	169	82710	2.05	-	-	82710
71	129	100624	1.27	-	-	100624
72	114	68313	1.66	-	-	68313
73	299	128061	2.33	-	-	128061
74	96	101283	.94	-	-	101283
1975	116	94997	1.23	-	-	94997
76	97	54430	1.79	-	-	54430
77	37	20382	1.81	-	-	20382
78	48	35154	1.37	1.30 ⁴	17	37058
79 ³	56	39994	1.41	1.88 ⁵	23	27574
1980 ⁶	44	33047 ⁷	-	1.33 ⁸	25	33628

¹ Effort adjusted to vessel class and gear (from Clay and Beanlands, 1980).

² Data from Canadian and Joint Canada-USSR and Canada-Cuba observer programs.

³ Effort and CPUE calculated from provisional 1979 catch statistics.

⁴ ICNAF Res. Doc. 79/17 (Seaward of Small Mesh Gear Line).

⁵ ICNAF Res. Doc. 80/18 (Seaward of Small Mesh Gear Line).

⁶ Provisional NAFO statistics.

⁷ Estimated from observer program, using 1980 FLASH effort adjusted by observer hours divided by observer days.

⁸ Observer data seaward of Small Mesh Gear Line.

⁹ Effort readjusted using reported catch and Observer Program directed CPUE.

Table 3. Summary of Observed 1978-1980 Data for 4VWX and 3+4 Squid

COUNTRY	SPECIES	Quota 1980 (t)	FLASH Catch (t)	%	FLASH CPUE (t/day)		1980 (D.F.) Assign Report	% Observed to Reported Days		% Observed to Reported (t)		Observed Directed t/day	
					1980	1979		1980	1979	1980	1979	1980	1979
Bulgaria	S. Hake Squid	1200	761	63	11.27	15.63	63	78.7	57.6	75.1	80.5	14.57	21.83
		500	202	40	12.48	29.65	20	50.0	117.2	30.9	97.3	7.70	24.58
Cuba	Argentine S. Hake Squid	1400	4.7	3	6.04	14.17	122	-	-	-	-	0	0
		11200	2280	20	10.20	14.50	753	49.6	82.7	52.4	88.9	6.39	16.51
FRG and EEC	No catch in 1980	2250	1602	71	10.20	22.39	139	53.4	44.5	37.0	53.7	7.06	17.49
France	Squid	2500	364	15	9.10	22.40	131	102.5	74.4	100.8	68.1	8.95	24.83
Ireland, Italy No catch in 1980													
Japan	Argentine Squid	3100	1527	49	8.09	9.29	241	20.0	82.6	11.2	23.8	4.52	8.91
		17000	16135	95	11.38	9.68	1468	45.5	65.5	51.3	15.3	12.84	14.10
Poland	Squid	1000	489	49	11.36	34.00	35	67.4	54.3	99.9	54.1	16.84	33.86
Portugal	Squid	1800	1647	92	8.90	17.87	212	44.9	42.7	56.6	46.0	11.22	19.25
Romania No catch in 1980													
Spain	Squid	5950	4820	81	8.36	8.51	912	14.4	20.6	18.1	18.0	10.47	9.74
USSR	Argentine S. Hake Squid	9350	523	6	4.58	4.02	754	41.4	40.0	54.3	47.0	6.00	4.72
		56600	39491	70	17.32	24.34	2556	61.6	42.4	59.8	44.2	16.82	25.36
		7660	6774	88	13.23	28.07	300	57.6	65.5	59.4	54.3	13.63	23.28

Table 4. Summary of 1980 Observer Program Silver Hake Sampling

COUNTRY	SAMPLE	APRIL	MAY	JUNE	JULY	AUGUST	SEPTEMBER	OCTOBER	NOVEMBER	TOTAL
Bulgaria	Meas. Otoliths	-	1333	3735	2738	-	-	-	210	8016 119
Cuba	Meas. Otoliths	1507 86	7451 51	19741	13648 43	5371 58	1032	-	-	48750 238
France (Main)	Meas. Otoliths	-	-	-	-	-	2028	-	-	2028
Japan	Meas. Otoliths	-	-	-	-	14291 239	15182 20	16660 201	2887 139	49020 599
Portugal	Meas. Otoliths	-	-	-	430 28	-	-	-	-	430 28
Spain	Meas. Otoliths	-	-	-	2624	114	981	206	-	3925 - - - -
USSR	Meas. Otoliths	9537 200	66908 748	38027 215	49882 265	17089 304	-	23	392 15	181858 1747
Total	Meas. Otoliths	11044 286	75692 824	61503 285	69322 360	36865 601	19223 20	16889 201	3489 154	249027 2731
	Oto/Meas	.026	.011	.005	.005	.016	.001	.012	.044	.009
	No. Smpls.	55	378	308	347	184	96	84	17	1470
	Catch(t)	1373	10028	13460	14250	4798	209	90	53	44373
	No. Smpls. (¹ 000 t)	40.058	37.694	22.883	24.351	38.349	459.330	933.333	320.755	33.128

Table 5. July - August Groundfish Cruise Min. Population Estimates (No.'s '000) per NAFO Divisions 4VWX.

Age	YEAR								
	1972	1973	1974	1975	1976	1977	1978	1979	1980
1	27497	69115	30601	17556	15572	28658	13324	3845	7382
2	45304	130669	98501	16689	44120	42654	12308	32784	11256
3	6725	8880	14023	2653	4062	27715	8212	8691	14747
4	3628	7377	1751	1491	1846	8383	4392	1618	4228
5	1564	6864	1732	766	547	5394	3435	503	2171
6	899	3172	1972	444	314	2423	1455	414	1594
7	139	1105	363	128	84	1321	600	239	769
8	327	682	208	202	119	496	232	-	445
9	58	61	-	19	80	107	468	-	189
10+	223	342	18	-	-	256	220	-	331
4X	692	522	32878	80	7569	230	111	18	61
Total	87056	228791	182051	40032	74225	117637	44767	48112	43173

TABLE 6 SCOTIAN SHELF JULY - AUGUST GROUND FISH SURVEY BIOMASS AT AGE (TONS) FOR SILVER HAKE ,

AGE	1972	1973	1974	1975	1976	1977	1978	1979	1980
1	1552	3117	2353	1179	1092	1780	654	235	303
2	5434	16764	15507	2592	7270	6282	1357	5051	1589
3	1417	1922	3491	646	1113	5832	1432	1739	3146
4	878	1848	662	354	561	2436	995	397	1186
5	432	2030	837	366	248	2146	975	143	700
6	505	1396	1297	203	185	1253	480	142	584
7	68	537	432	145	78	883	230	98	400
8	416	598	293	254	166	535	116	0	268
9	52	72	0	31	77	117	368	0	169
10	0	592	33	0	0	0	145	0	481
TOTAL 1+	10754	28876	24906	5771	10789	21263	6752	7805	8826

TABLE 7. SCOTIAN SHELF COMMERCIAL SILVER HAKE REMOVALS AT AGE. (numbers '000)

AGE	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980
1	2	18946	48573	19070	6547	8371	89	2270	27836	187298	219607	379314	245401	101158	144956	153535	2131	28807	10533	6272
2	7	52677	388718	232433	115396	31209	5398	14130	189232	748021	410149	460610	1478425	390044	365624	381651	43528	91101	52675	60575
3	1	7412	157119	121703	82387	14964	3607	4831	72147	216246	175005	71536	96490	150741	52788	72418	78226	90038	75250	82011
4	1	2158	72382	50964	37225	7009	1779	1616	21971	59832	74755	47903	106351	7095	60750	31295	29556	43031	50720	35887
5	1	714	32474	20575	14303	2672	855	627	6200	20695	22035	17822	96646	9789	38610	5582	6980	19511	32315	15293
6	1	246	15902	9402	6083	1063	442	312	2038	9636	1877	7452	19611	3245	4799	2669	2004	8618	18485	6179
7	1	67	5087	2971	1781	289	136	99	571	3608	5139	1160	15157	93	311	514	483	3234	5535	1682
8	1	18	2214	1146	588	78	54	32	143	1988	1333	437	5458	109	363	105	564	2016	1924	343
9	1	4	1121	570	209	20	20	9	29	1114	2062	607	483	60	360	390	522	421	1255	90
10	1	2	808	350	78	9	10	2	16	680	1900	2000	816	77	1000	82	1	645	533	44
TOTAL	17	82244	724398	459184	264597	65684	12390	23928	320183	1249118	913862	988841	2064838	662411	669561	648241	163995	287422	249225	208376

TABLE 8. SCOTIAN SHELF SILVER HAKE MEAN WEIGHTS AT AGE (KG.)

AGE	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980
1,000	0.039	0.077	0.081	0.077	0.067	0.072	0.078	0.073	0.062	0.060	0.040	0.056	0.045	0.063	0.067	0.063	0.062	0.049	0.061	0.041
2,000	0.096	0.104	0.129	0.140	0.151	0.128	0.150	0.128	0.133	0.126	0.128	0.119	0.128	0.129	0.155	0.148	0.147	0.110	0.154	0.141
3,000	0.001	0.160	0.189	0.189	0.195	0.195	0.196	0.175	0.175	0.167	0.188	0.209	0.216	0.204	0.243	0.246	0.210	0.174	0.200	0.213
4,000	0.001	0.216	0.251	0.241	0.240	0.240	0.259	0.233	0.214	0.222	0.254	0.240	0.250	0.310	0.237	0.273	0.290	0.226	0.245	0.280
5,000	0.001	0.256	0.313	0.302	0.288	0.278	0.322	0.309	0.250	0.303	0.315	0.274	0.295	0.396	0.477	0.407	0.397	0.283	0.285	0.322
6,000	0.001	0.304	0.373	0.362	0.336	0.311	0.376	0.376	0.290	0.404	0.450	0.557	0.439	0.539	0.457	0.528	0.516	0.329	0.344	0.366
7,000	0.001	0.310	0.407	0.391	0.359	0.324	0.389	0.382	0.293	0.470	0.587	0.483	0.485	0.975	1.133	0.838	0.667	0.382	0.411	0.520
8,000	0.001	0.331	0.550	0.508	0.418	0.340	0.446	0.417	0.351	0.705	0.832	1.263	0.875	1.156	1.257	1.251	1.077	0.498	0.520	0.601
9,000	0.001	0.284	0.719	0.721	0.518	0.371	0.445	0.406	0.451	0.828	0.612	0.886	1.174	0.001	1.635	0.859	1.089	0.784	0.553	0.892
10,000	0.001	0.149	0.735	1.031	0.410	0.265	0.417	0.149	0.298	0.875	0.712	0.001	1.726	1.508	0.946	1.818	0.001	0.659	1.189	1.452
Ave. 1+	0.014	0.219	0.375	0.396	0.298	0.252	0.308	0.265	0.252	0.416	0.412	0.409	0.563	0.528	0.661	0.643	0.446	0.349	0.396	0.483

Table 9. Silver hake catch biomass (tons).

	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976
1	0	1459	3934	1468	439	603	7	166	1726	11238	8784	21242	11043	6373	9712	9673
2	1	5478	50145	32541	17425	3995	810	1809	25168	94251	52499	54813	189238	50316	56672	56484
3	0	1186	29695	23002	16065	2918	707	845	12626	36113	32901	14951	20842	30751	12827	17815
4	0	466	18168	12282	8934	1682	461	377	4702	13283	18988	11497	26588	2199	14398	8544
5	0	183	10164	6214	4119	743	275	194	1550	6271	6941	4883	28511	3876	18417	2272
6	0	75	5931	3404	2044	331	166	117	591	3893	845	4151	8609	1749	2193	1409
7	0	21	2070	1162	639	94	53	38	167	1696	3017	560	7351	91	352	431
8	0	6	1218	582	246	27	24	13	50	1402	1109	552	4776	126	456	131
9	0	1	806	411	108	7	9	4	13	922	1262	538	567	0	589	335
10	0	0	594	361	32	2	4	0	5	595	1353	2	1408	116	946	149
1+	1	8875	122726	81426	50051	10401	2516	3562	46598	169663	127698	113188	298933	95598	116562	97243
2+	1	7416	118792	79958	49613	9798	2509	3397	44872	158425	118914	91946	287890	89225	106850	87570
3+	0	1938	68647	47417	32188	5804	1699	1588	19704	64174	66415	37134	98652	38909	50179	31086
4+	0	752	38952	24415	16123	2886	992	743	7078	28061	33514	22183	77810	8158	37351	13271
1	1977	1978	1979	1980												
1	132	1412	643	257												
2	6399	10021	8112	8541												
3	16427	15667	15050	17468												
4	8571	9725	12426	10048												
5	2771	5522	9210	4924												
6	1034	2835	6359	2261												
7	322	1235	2275	875												
8	607	1004	1000	206												
9	568	330	694	80												
10	0	425	634	64												
1+	36833	48176	56402	44726												
2+	36700	46764	55760	44468												
3+	30302	36743	47648	35927												
4+	13874	21076	32598	18459												

TABLE 10. SILVER HAKE CPUE AT AGE (NUMBERS PER HOUR)

AGE	1963	1964	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980
1.000	0.880	0.493	0.146	0.189	0.023	0.118	0.773	2.265	2.182	5.553	1.916	0.999	1.526	2.821	0.105	0.777	0.382	0.187
2.000	7.040	6.010	2.582	0.706	1.414	0.732	5.252	9.044	4.076	6.743	11.545	3.851	3.849	7.012	2.136	2.458	1.910	1.801
3.000	2.846	3.147	1.843	0.339	0.945	0.250	2.002	2.615	1.739	1.047	0.753	1.488	0.556	1.330	3.838	2.430	2.729	2.439
4.000	1.311	1.318	0.833	0.159	0.466	0.084	0.610	0.723	0.743	0.701	0.830	0.070	0.639	0.575	1.450	1.161	1.839	1.067
5.000	0.588	0.532	0.320	0.060	0.224	0.032	0.172	0.250	0.219	0.261	0.755	0.097	0.406	0.103	0.342	0.526	1.172	0.455
6.000	0.288	0.243	0.136	0.024	0.116	0.016	0.057	0.117	0.019	0.109	0.153	0.032	0.051	0.049	0.098	0.233	0.670	0.184
7.000	0.092	0.077	0.040	0.007	0.036	0.005	0.016	0.044	0.051	0.017	0.118	0.001	0.003	0.009	0.024	0.087	0.201	0.050
8.000	0.040	0.030	0.013	0.002	0.014	0.002	0.004	0.024	0.013	0.006	0.043	0.001	0.004	0.002	0.028	0.054	0.070	0.010
9.000	0.020	0.015	0.005	0.000	0.005	0.000	0.001	0.013	0.020	0.009	0.004	0.001	0.004	0.007	0.026	0.011	0.045	0.003
10.000	0.015	0.009	0.002	0.000	0.003	0.000	0.000	0.008	0.019	0.029	0.006	0.001	0.011	0.002	0.000	0.017	0.019	0.001

Table 11. Silver hake population numbers $F = 0.25$, $M = 0.4$.

I	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970	1971	1972	1973
1 I	897002	1501990	1110553	443333	307414	478603	893677	1543809	2798271	1798856	1749558	3959301	1506092
2 I	336515	601277	991302	704658	281562	200706	313964	598977	1032988	1852947	1052463	992965	2343443
3 I	143765	225567	359920	346234	282046	94258	108985	206037	389938	537502	629640	369685	288489
4 I	65302	96368	145134	112623	132446	121609	50932	70102	134155	202314	183251	278778	189239
5 I	20818	43772	62830	38025	33768	58304	75778	32684	45668	71939	86629	61633	147651
6 I	9260	13954	28757	15529	8643	10925	36895	50096	21395	25536	31278	40028	26722
7 I	5460	6206	9152	6257	2712	813	6453	24369	33325	12673	9228	19430	20731
8 I	3596	3659	4105	1970	1762	360	309	4214	16254	21871	5541	1978	12074
9 I	82	2410	2438	939	382	699	177	163	2799	10778	13033	2623	968
10 I	24138	54	1612	716	163	85	452	102	102	1852	6313	7048	1261
1+I	1505938	2495257	2715804	1670284	1050897	966362	1487622	2530553	4474894	4536268	3766934	5733470	4536670
2+I	608936	993267	1605250	1226952	743483	487759	593945	986743	1676623	2737412	2017375	1774168	3030578
3+I	272421	391990	613948	522294	461922	287053	279981	387767	643635	884465	964913	781203	687135
4+I	128656	166423	254028	176059	179875	192795	170996	181730	253697	346963	335273	411518	398646
I	1974	1975	1976	1977	1978	1979	1980						
1 I	1492203	1703449	1129308	1021308	1124040	1048763	666069						
2 I	808646	917432	1023176	631294	682859	729881	694383						
3 I	360425	222711	315626	373386	387531	383147	446127						
4 I	114381	118184	106068	152279	186242	186053	195221						
5 I	39778	70863	29483	45478	77877	89611	83189						
6 I	19846	18649	15889	15193	24770	36229	33611						
7 I	1856	10647	8572	8466	8543	9546	9151						
8 I	1487	1168	6882	5325	5279	3079	1869						
9 I	3625	907	486	4527	3108	1888	489						
10 I	254	2381	313	6	2607	1738	239						
1+I	2842500	3066390	2635804	2257262	2502857	2489937	2130347						
2+I	1350297	1362942	1506496	1235954	1378817	1441174	1464278						
3+I	541651	445509	483320	604660	695958	711293	769895						
4+I	181226	222799	167694	231274	308427	328146	323768						

TABLE 13. SILVER HAKE F MATRIX ASSUMING A TERMINAL F OF .25 AND M=.4

AGE	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980
1,000	0.000	0.016	0.055	0.055	0.027	0.022	0.000	0.002	0.013	0.138	0.170	0.129	0.225	0.088	0.111	0.181	0.003	0.032	0.012	0.011
2,000	0.000	0.115	0.646	0.510	0.686	0.213	0.021	0.030	0.258	0.681	0.647	0.834	1.456	0.882	0.563	0.602	0.088	0.176	0.091	0.111
3,000	0.000	0.042	0.759	0.554	0.435	0.215	0.042	0.029	0.261	0.683	0.421	0.274	0.530	0.717	0.344	0.330	0.295	0.331	0.271	0.250
4,000	0.000	0.029	0.946	0.795	0.414	0.073	0.044	0.029	0.224	0.456	0.703	0.242	1.138	0.081	0.981	0.449	0.272	0.330	0.398	0.250
5,000	0.000	0.021	1.004	1.092	0.714	0.057	0.014	0.024	0.184	0.431	0.383	0.455	1.566	0.355	1.088	0.266	0.210	0.367	0.570	0.250
6,000	0.000	0.023	1.113	1.343	1.918	0.125	0.015	0.008	0.124	0.622	0.077	0.270	2.262	0.220	0.373	0.234	0.179	0.556	0.953	0.250
7,000	0.000	0.014	1.134	0.853	1.580	0.560	0.026	0.005	0.021	0.423	1.125	0.076	2.182	0.067	0.036	0.076	0.074	0.626	1.199	0.250
8,000	0.000	0.006	1.071	1.227	0.514	0.304	0.237	0.009	0.011	0.117	0.344	0.316	0.786	0.094	0.509	0.019	0.137	0.637	1.401	0.250
9,000	0.015	0.002	0.806	1.316	1.075	0.035	0.147	0.069	0.013	0.134	0.212	0.327	0.918	0.020	0.649	3.825	0.150	0.179	1.622	0.250
10,000	0.000	0.046	0.893	0.859	0.834	0.137	0.027	0.024	0.210	0.575	0.446	0.415	1.390	0.451	0.690	0.376	0.209	0.352	0.457	0.250

AVE, 1+F 0.002 0.031 0.843 0.860 0.820 0.174 0.057 0.023 0.132 0.426 0.453 0.334 1.245 0.298 0.544 0.636 0.162 0.358 0.697 0.212

Table 14. Results of VPA Analysis for Scotia Shelf
Silver Hake Assuming an $M = 0.40$.

Terminal F.	Weighted F. vs Effort	CPUE vs 2+ Population Biomass
<u>0.10</u>		
r	.933	.728
Obs. ¹	.170	.247
Pred. ¹	.073	.147
Diff. ¹	.097	.100
<u>0.20</u>		
r	.933	.858
Obs.	.208	.184
Pred.	.147	.147
Diff.	.061	.037
<u>0.25</u>		
r	.930	.827
Obs.	.222	.154
Pred.	.184	.147
Diff.	.038	.007
<u>0.30</u>		
r	.927	.787
Obs.	.234	.134
Pred.	.221	.147
Diff.	.013	.007
<u>0.35</u>		
r	.923	.751
Obs.	.246	.122
Pred.	.258	.147
Diff.	-.012	-.025
<u>0.40</u>		
r	.916	.730
Obs.	.256	.112
Pred.	.296	.147
Diff.	-.040	-.035

¹ 1980 Observed 1980 predicted, 1980 Difference between observed and predicted.

TABLE 15. YIELD PER RECRUIT FOR SILVER HAKE ASSUMING AVERAGE WIGHTS FROM 1977 TO 1980.

YIELD PER RECRUIT				
FISHING MORTALITY	CATCH (NUMBER)	YIELD (KG)	AVG. WEIGHT (KG)	YIELD PER UNIT EFFORT
F0.1---	0.200	0.18900	0.045	1.000
	0.400	0.28837	0.060	0.669
	0.447	0.30533	0.062	0.619
	0.600	0.35033	0.066	0.495
	0.800	0.39353	0.070	0.390
	1.000	0.42594	0.072	0.321
	1.200	0.45154	0.073	0.272
	1.400	0.47251	0.074	0.236
	1.600	0.49017	0.074	0.208
	1.800	0.50539	0.075	0.186
	2.000	0.51871	0.075	0.168
	2.200	0.53054	0.075	0.153
	2.400	0.54117	0.075	0.140
	2.600	0.55081	0.075	0.129
FMAX---	2.638	0.55256	0.075	0.128
	2.800	0.55962	0.075	0.120
	3.000	0.56772	0.075	0.112
	3.200	0.57523	0.075	0.105
	3.400	0.58221	0.075	0.099
	3.600	0.58873	0.075	0.093
	3.800	0.59484	0.075	0.088
	4.000	0.60060	0.075	0.084

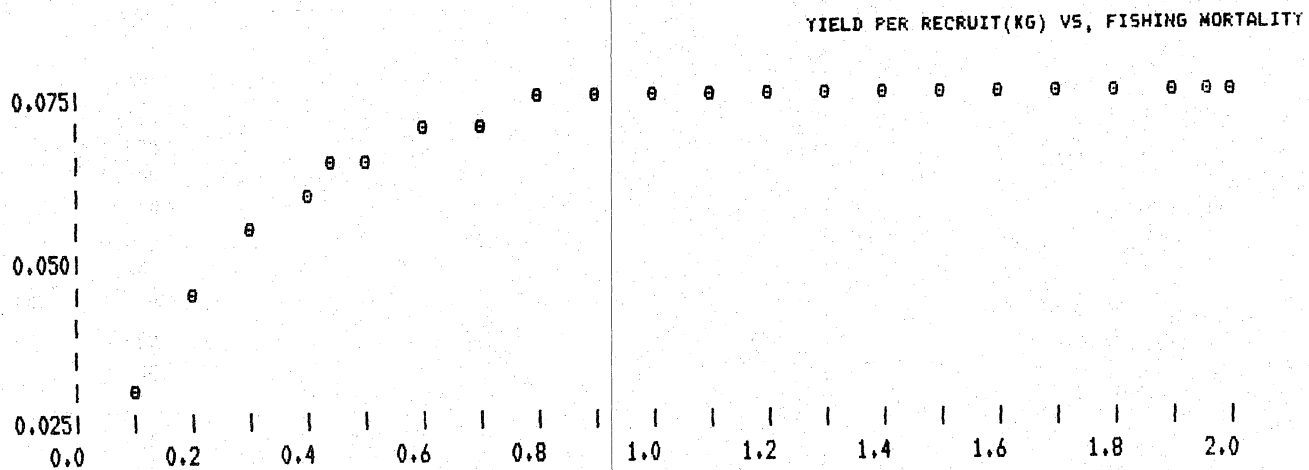


Table 16. Catch projections for silver hake. $F=.447$
 $M = .4$.

AGE	1	2	3	4	5	6	7	8	9	10
NATAGE	666069	694383	446127	195221	83189	33611	9151	1869	489	239
CATCH	6272	60575	82011	35887	15293	6179	1682	343	90	44
WATAGE	0.053	0.138	0.199	0.260	0.322	0.389	0.495	0.674	0.829	0.825
RECRUT	1384896									

YEAR	POP NUMBERS	POP BIOMASS	CATCH NUMBERS	CATCH BIOMASS	MATURE F

1980	2130347	317214	208376	42870	0.2500
1981	2644448	340830	336053	72527	0.4470
1982	2887406	359445	338336	68346	0.4470

Option 1

YEAR	POP NUMBERS	POP BIOMASS	CATCH NUMBERS	CATCH BIOMASS	MATURE F

1980	2130347	317214	208376	42870	0.2500
1981	2644448	340830	371476	80000	0.5043
1982	2859399	351673	330254	66052	0.4470

Option 2

YEAR	POP NUMBERS	POP BIOMASS	CATCH NUMBERS	CATCH BIOMASS	MATURE F

1980	2130347	317214	208376	42870	0.2500
1981	2644448	340830	303377	65600	0.3963
1982	2913327	366668	345829	70479	0.4470

Option 3

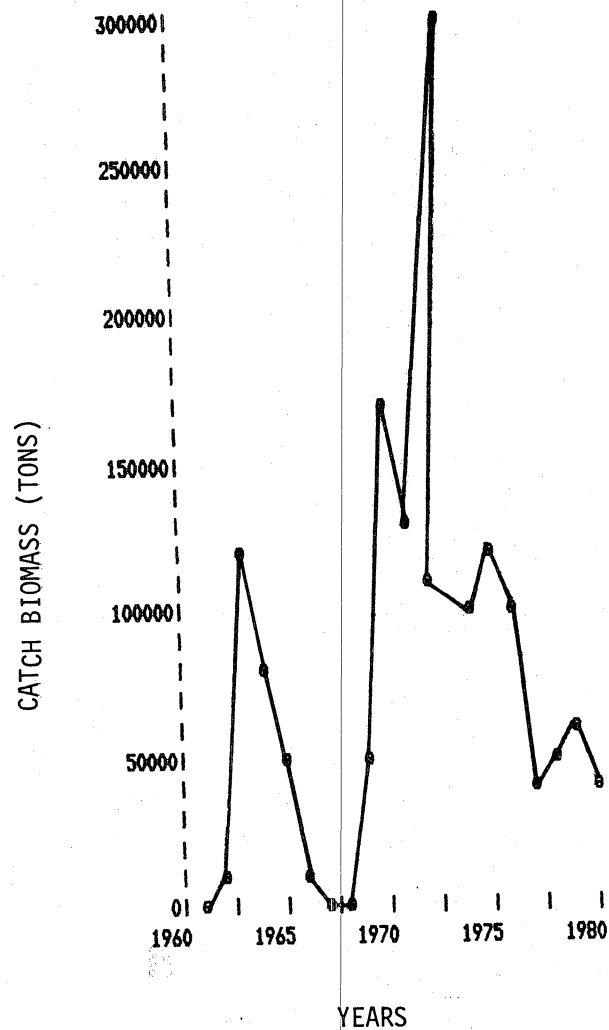


Fig. 1. Catch Biomass (t) for the Scotian Shelf silver hake stock.

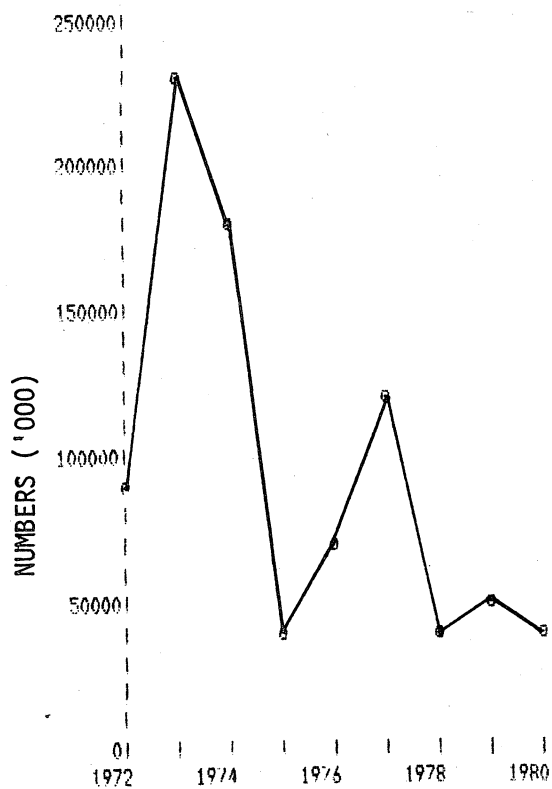


Fig. 2. July-August research vessel numbers.

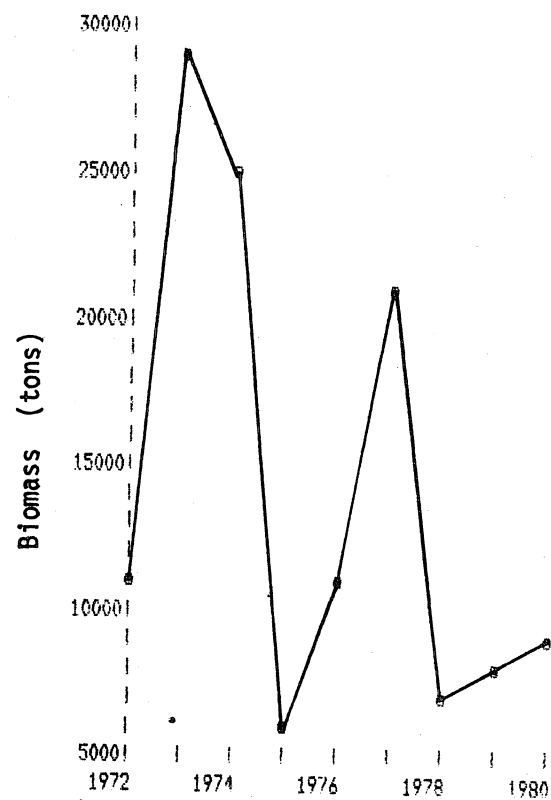


Fig. 3. July-August research vessel biomass (t)

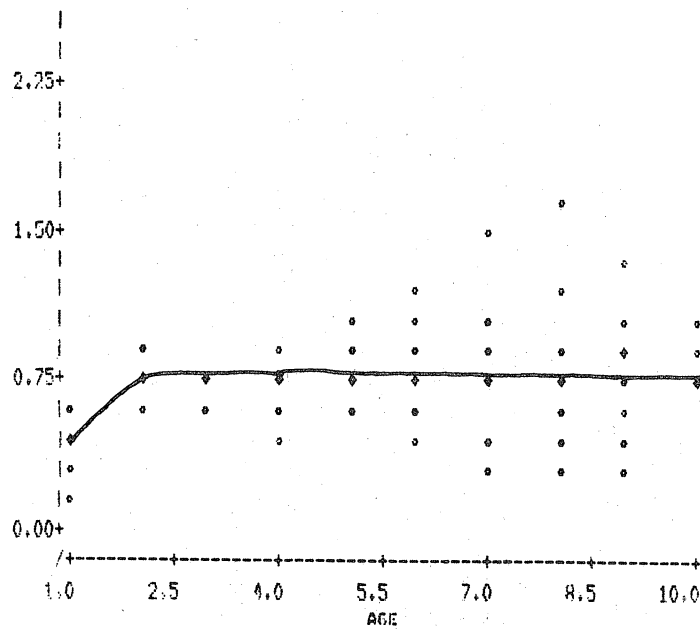


Fig. 5. Partial recruitment pattern using average F's from 1961-1976.

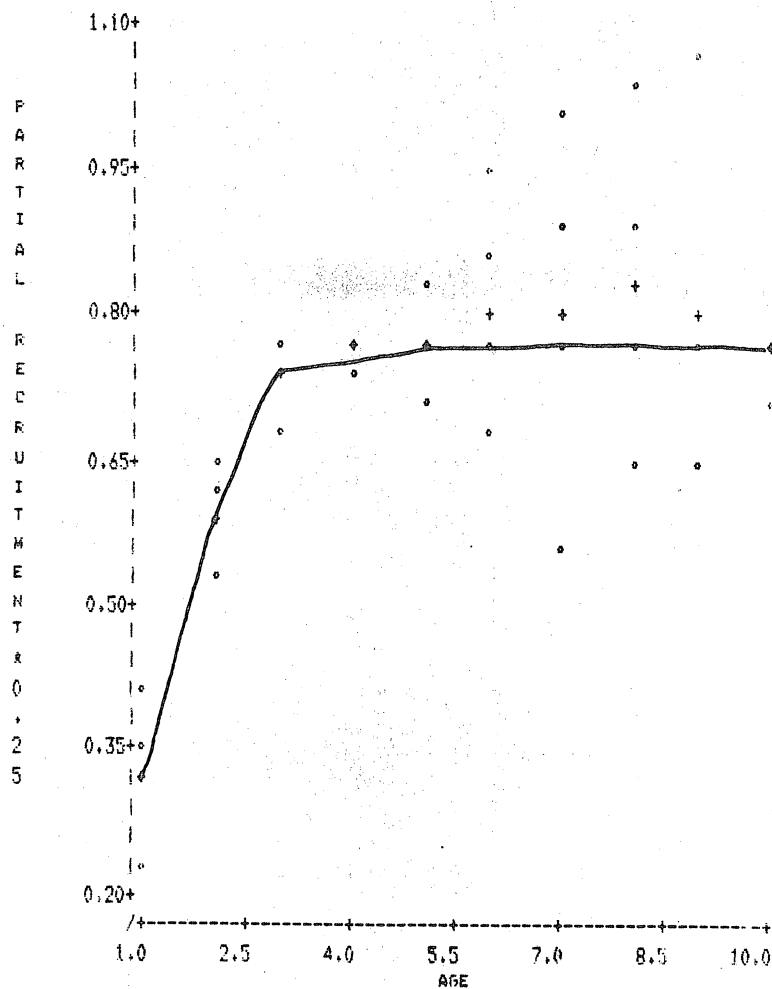


Fig. 4. Partial recruitment pattern using average F's from 1977-1980.

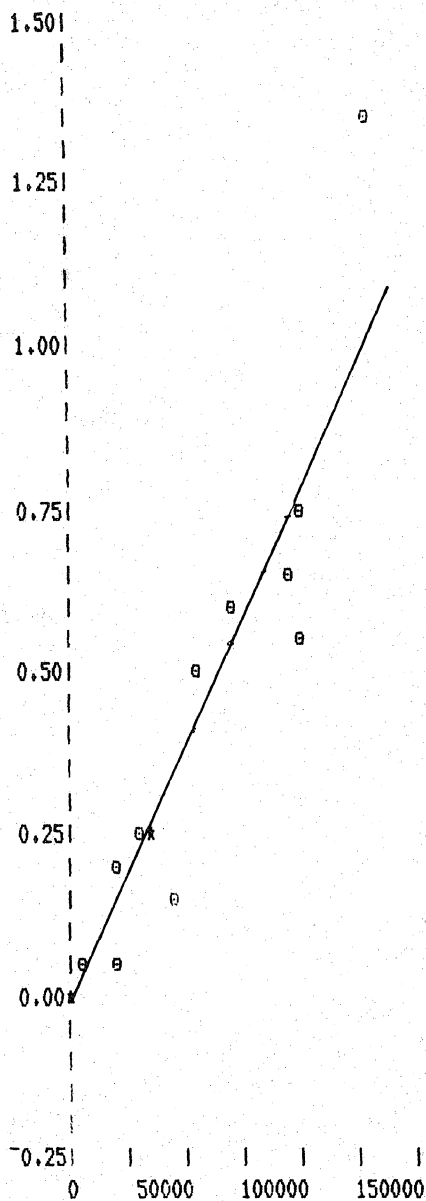


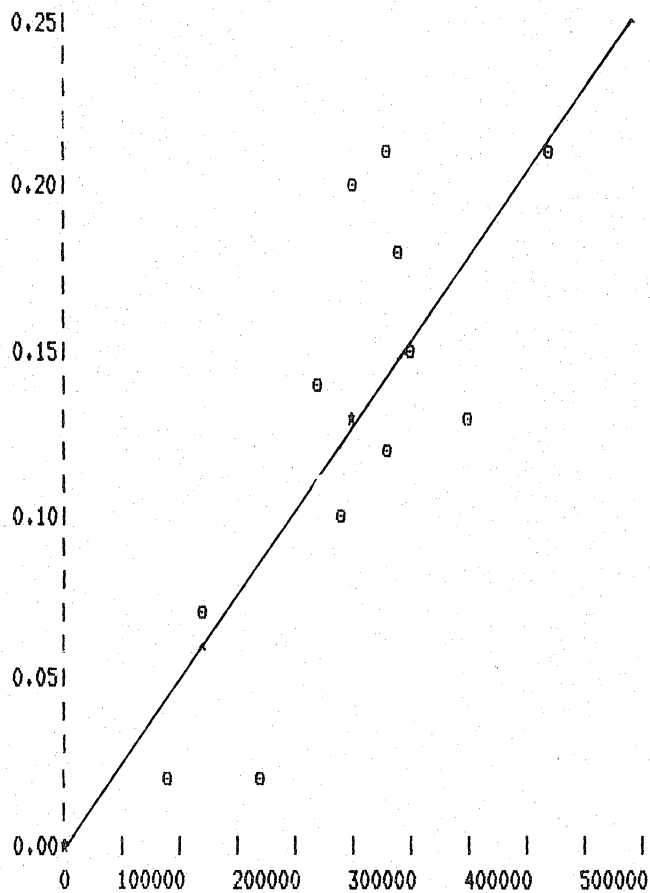
FIGURE 6, WEIGHTED F AND EFFORT (HRS.) FOR THE 4VMX SILVER HAKE STOCK, ($R = 0.930$).

PREDICTED AND CALCULATED WEIGHTED F AND EFFORT (HRS.) FOR THE 4VMX SILVER HAKE STOCK,

YEAR	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980
PR F	0.315	0.042	0.095	0.243	0.656	0.815	0.529	1.058	0.821	0.765	0.406	0.105	0.252	0.168	0.222
FWT	0.157	0.026	0.028	0.252	0.657	0.560	0.595	1.358	0.744	0.656	0.523	0.180	0.259	0.231	0.184
ACTF	0.834	0.137	0.027	0.024	0.210	0.575	0.446	0.415	1.390	0.451	0.690	0.376	0.209	0.352	0.457
EFF	44175	3818	19295	36033	82710	100624	68313	128061	101283	94997	54430	20382	37058	27574	33628

REGRESSION OF WEIGHTED F AGAINST EFFORT (HRS.) FOR THE 4VMX SILVER HAKE STOCK,

REGRESSION COEFFICIENT $8.852340046E^{-6}$
 INTERCEPT -0.07579807707
 T-VALUE 9.090271059
 STANDARD ERROR $9.738257516E^{-7}$
 DEGREES OF FREEDOM 14
 OBSERVATIONS 15
 R^2 0.8640636997
 R 0.9295502675



POPULATION BIOMASS (T)

FIGURE 7. POPULATION BIOMASS AND CPUE FOR THE 4VWX SILVER HAKE STOCK,
($R = 0.835$);
SPANNING THE YEARS 1966 - 1980 .

REGRESSION OF YEARLY CPUE AGAINST YEARLY POPULATION BIOMASS FOR THE 4VWX SILVER HAKE STOCK,

YEAR	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980
PRED CPUE	0.041	0.057	0.082	0.135	0.223	0.186	0.159	0.250	0.122	0.144	0.151	0.131	0.114	0.146	0.153
DIR, CPUE	0.025	0.073	0.020	0.138	0.213	0.131	0.150	0.250	0.098	0.125	0.179	0.200	0.140	0.207	0.147
BIOMASS	92518	121205	165593	261489	419513	352335	304856	467663	236632	276937	289407	253799	222378	279775	293348

REGRESSION OF YEARLY CPUE AGAINST YEARLY POPULATION BIOMASS FOR THE 4VWX SILVER HAKE STOCK,

REGRESSION COEFFICIENT $5.558407997E^{-7}$
 INTERCEPT -0.0099854992
 T-VALUE 5.481742508
 STANDARD ERROR $1.013985606E^{-7}$
 DEGREES OF FREEDOM 14
 OBSERVATIONS 15
 R^2 0.6980220509
 R 0.8354771396

APPENDIX I

Preliminary 1980 monthly observed catch rates for 4VWX Silver hake, Argentine and Squid.

COUNTRY	DIRECTED SPECIES		M O N T H								TOTALS
			APRIL	MAY	JUNE	JULY	AUGUST	SEPTEMBER	OCTOBER	NOVEMBER	
USSR	S. Hake	Catch (T)	683.6	6414.4	8845.8	6437.4	758.7	4.8	-	-	23144.7
		Hrs.	575.3	5023	6729.4	4034.7	1052.7	9.1	-	-	17424.2
		Days	48	381	526	316	89	4	-	-	1364
		C/hr.	1.2	1.3	1.3	1.6	0.7	0.5	-	-	1.32
	Squid	Catch (t)	0.38	-	7.5	659.2	1354.9	36.3	-	-	2058.3
		Hrs.	2.3	-	18.8	594.9	1230.5	11.7	-	-	1858.2
		Days	1	-	2	48	98	2	-	-	151
		C/hr.	1.7	-	0.4	1.1	1.1	3.1	-	-	1.1
	Argentine	Catch (T)	-	-	22.3	23.1	25.8	0.7	-	-	71.9
		Hrs.	-	-	40.5	16.9	20.5	1.0	-	-	78.9
		Days	-	-	6	3	2	1	-	-	12
		C/hr	-	-	0.001	1.4	1.3	0.7	-	-	0.91
CUBA	S. Hake	Catch (5)	10.6	261.6	151.5	627.7	65.1	2.4	-	-	1118.6
		Hrs.	77.4	609.6	322.6	778.3	231.7	2.0	-	-	2021.6
		Days	8	55	26	63	19	1	-	-	172
		C/hr.	1.4	0.4	0.47	0.8	0.3	1.2	-	-	0.55
	Squid	Catch (T)	-	-	17.4	84.8	222.5	176.9	-	-	501.6
		Hrs.	-	-	41.9	186.9	431.5	143.2	-	-	803.5
		Days	-	-	4	15	37	14	-	-	70
		C/hr.	-	-	0.4	0.45	0.5	1.2	-	-	0.62
	Argentine	Catch (T)	-	-	-	-	-	-	-	-	-
		Hrs.	-	-	-	-	-	-	-	-	-
		Days	-	-	-	-	-	-	-	-	-
	BULGARIA	S. Hake	Catch (T)	-	284	202.7	285.9	-	-	-	-
Hrs.			-	70.1	225.4	188.9	-	-	-	-	484.4
Days			-	7	23	18	-	-	-	-	48
		C/hr.	-	0.4	0.90	1.5	-	-	-	-	1.6
Squid		Catch (T)	-	-	5.1	33.5	-	-	-	-	38.6
		Hrs.	-	-	11.6	37.2	-	-	-	-	48.8
		Days	-	-	2	3	-	-	-	-	5
		C/hr.	-	-	0.44	0.9	-	-	-	-	0.79
Argentine		Catch (T)	-	-	-	-	-	-	-	-	-
		Hrs.	-	-	-	-	-	-	-	-	-
		Days	-	-	-	-	-	-	-	-	-
		C/hr.	-	-	-	-	-	-	-	-	-
JAPAN	S. Hake	Catch (T)	-	-	-	0.02	2.9	0.1	-	-	3.02
		Hrs.	-	-	-	4.5	13.3	10.5	-	-	28.3
		Days	-	-	-	1	2	1	-	-	4
		C/hr	-	-	-	0.005	0.2	0.01	-	-	0.11
	Squid	Catch (T)	-	-	0.02	313.3	3499.2	3803.8	1011.4	-	8627.72
		Hrs.	-	-	1.4	301.8	2559.0	2585.2	586.7	-	6034.1
		Days	-	-	1	29	245	310	71	-	656
		C/hr	-	-	0.01	1.0	1.4	1.5	1.7	-	1.43
	Argentine	Catch (T)	-	1.3	-	9.8	104.2	9.1	24.8	-	149.2
		Hrs.	-	1.2	-	59.5	211.8	34.8	24.8	-	332.1
		Days	-	1	-	5	18	5	4	-	32
		C/hr.	-	0.05	-	0.16	0.07	0.3	1.0	-	0.45
PORTUGAL	S. Hake	Catch (T)	-	-	-	-	-	-	-	-	-
		Hrs.	-	-	-	-	-	-	-	-	-
		Days	-	-	-	-	-	-	-	-	-
		C/hr	-	-	-	-	-	-	-	-	-
	Squid	Catch (T)	-	-	-	51.2	-	643.5	250.5	-	945.2
		Hrs	-	-	-	154.3	-	668.5	148.2	-	971
		Days	-	-	-	10	-	55	18	-	83
		C/hr	-	-	-	0.33	-	0.9	1.7	-	0.97
	Argentine	Catch (T)	-	-	-	-	-	-	-	-	-
		Hrs	-	-	-	-	-	-	-	-	-
		Days	-	-	-	-	-	-	-	-	-
		C/hr.	-	-	-	-	-	-	-	-	-
SPAIN	S. Hake	Catch (T)	-	-	-	0.9	-	-	-	-	0.9
		Hrs.	-	-	-	3.4	-	-	-	-	3.4
		Days	-	-	-	1	-	-	-	-	1
		C/hr	-	-	-	0.30	-	-	-	-	0.26
	Squid	Catch (T)	-	-	-	413.1	149.9	269.9	45.6	-	878.5
		Hrs	-	-	-	490.5	193.5	241.8	22.1	-	947.9
		Days	-	-	-	36	17	26	4	-	83
		C/hr	-	-	-	0.8	0.8	1.1	2.1	-	0.93

COUNTRY	DIRECTED SPECIES		M O N T H								TOTALS
			APRIL	MAY	JUNE	JULY	AUGUST	SEPTEMBER	OCTOBER	NOVEMBER	
FRANCE - MET	Argentine	Catch (T)	-	-	-	-	-	-	-	-	-
		Hrs	-	-	-	-	-	-	-	-	-
		Days	-	-	-	-	-	-	-	-	-
		C/hr	-	-	-	-	-	-	-	-	-
	S. Hake	Catch (T)	-	-	-	-	-	0.35	-	-	0.35
		Hrs.	-	-	-	-	-	9.5	-	-	9.5
		Days	-	-	-	-	-	1	-	-	1
		C/hr	-	-	-	-	-	0.04	-	-	0.04
	Squid	Catch (T)	-	-	-	-	8.2	358.7	-	-	366.9
		Hrs	-	-	-	-	21.3	531.2	-	-	919.4
		Days	-	-	-	-	2	39	-	-	41
		C/hr	-	-	-	-	0.4	0.7	-	-	0.40
POLAND	Argentine	Catch (T)	-	-	-	-	-	-	-	-	-
		Hrs.	-	-	-	-	-	-	-	-	-
		Days	-	-	-	-	-	-	-	-	-
		C/hr	-	-	-	-	-	-	-	-	-
	S. Hake	Catch (T)	-	-	-	-	-	-	-	-	-
		Hrs	-	-	-	-	-	-	-	-	-
		Days	-	-	-	-	-	-	-	-	-
		C/hr	-	-	-	-	-	-	-	-	-
	Squid	Catch (T)	-	-	-	-	94.8	393.8	-	-	488.6
		Hrs.	-	-	-	-	96.1	290.7	-	-	386.8
		Days	-	-	-	-	8	21	-	-	29
		C/hr	-	-	-	-	1.0	1.4	-	-	1.26
	Argentine	Catch (T)	-	-	-	-	-	-	-	-	-
		Hrs.	-	-	-	-	-	-	-	-	-
		Days	-	-	-	-	-	-	-	-	-
		C/hr	-	-	-	-	-	-	-	-	-
Grand Totals for all areas from April - November for all countries for Silver Hake, Squid and Argentine.											
S. Hake	Catch (T)	694.2	6704.0	9199.9	7352.0	826.8	7.7	-	-	-	24784.6
	Hrs.	652.6	5702.8	7277.5	5009.8	1297.6	31.1	-	-	-	19971.4
	Days	56	443	575	399	110	7	-	-	-	1590
	C/hr	1.1	1.2	1.3	1.5	0.6	0.2	-	-	-	1.24
Squid	Catch (T)	0.36	-	30.0	1555.1	5329.6	5683.0	1307.5	-	-	13905.56
	Hrs	2.3	-	73.8	1765.5	4531.9	4472.3	757	-	-	11602.8
	Days	1	-	9	141	407	467	93	-	-	1118
	C/hr	1.7	-	0.41	0.88	1.2	1.3	1.7	-	-	1.20
Argentine	Catch (T)	-	1.3	22.3	32.9	130.1	9.8	24.8	-	-	221.2
	Hrs	-	1.2	40.5	76.4	232.3	35.8	24.8	-	-	411.0
	Days	-	1	6	8	20	6	4	-	-	45
	C/hr	-	0.05	0.001	0.43	0.6	0.3	1.0	-	-	0.54

APPENDIX 2

July-August groundfish minimum estimates (nos. '000) for Scotian Shelf Silver Hake.

Year	Strata	Sex	1	2	3	4	5	6	7	8	9	10	11	12	13+	UK.	TOTAL
1972	43-52	M	-	29	-	-	-	-	13	-	-	-	-	-	-	13	55
		F	-	-	-	-	26	-	-	-	-	-	-	-	-	-	26
		Total	-	29	-	-	26	-	13	-	-	-	-	-	-	13	81
	53-66	M	10495	14575	781	542	135	78	-	-	-	-	-	-	-	56	26661
		F	8796	26692	4406	1901	732	262	126	144	-	-	-	51	-	172	43343
		Total	19291	41267	5247	2443	867	340	126	144	-	-	-	51	-	228	70004
	70-85	M	3793	1408	302	491	141	68	-	-	-	-	-	-	-	61	6264
		F	3841	2600	1176	694	530	491	-	183	58	-	-	50	122	206	9952
		Total	7634	4008	1478	1185	671	559	-	183	58	-	-	50	122	267	16216
	90-95	M	99	-	-	-	-	-	-	-	-	-	-	-	-	105	204
		F	473	-	-	-	-	-	-	-	-	-	-	-	-	79	551
		Total	572	-	-	-	-	-	-	-	-	-	-	-	-	183	755
	Yearly Total	M	14387	16012	1083	1033	276	146	13	-	-	-	-	-	-	235	33184
		F	13110	29292	5642	2595	1288	753	126	327	58	-	-	101	122	457	53872
		Total	27497	45304	6725	3628	1564	899	139	327	58	-	-	101	122	692	87056
1973	43-52	M	-	-	-	51	-	-	-	-	-	-	-	-	-	-	51
		F	-	24	-	20	30	-	-	30	-	-	-	-	-	-	103
		Total	-	24	-	71	30	-	-	30	-	-	-	-	-	-	154
	53-66	M	13226	7593	220	80	24	-	-	-	-	-	-	-	-	42	21186
		F	13876	23715	2219	929	805	595	47	334	61	77	-	-	-	-	42659
		Total	27102	31308	2439	1009	829	595	47	334	61	77	-	-	-	42	63845
	70-85	M	19341	49421	1574	2579	2033	439	91	-	-	-	-	-	-	272	75751
		F	22672	49916	4867	3718	3972	2138	967	318	-	57	208	-	-	208	89041
		Total	42013	99337	6441	6297	6005	2577	1058	318	-	57	208	-	-	480	164792
	Yearly Total	M	32567	57014	1794	2710	2057	439	91	-	-	-	-	-	-	314	96988
		F	36548	73655	7086	4667	4807	2733	1014	682	61	134	208	-	-	208	131803
		Total	69115	130669	8880	7377	6864	3172	1105	682	61	134	208	-	-	522	228791
1974	43-52	M	-	130	112	31	-	-	25	-	-	-	-	-	-	-	299
		F	-	193	384	41	42	25	-	-	-	-	-	-	-	-	686
		Total	-	323	496	72	42	25	25	-	-	-	-	-	-	-	985
	53-66	M	7617	28089	2595	-	108	-	-	-	-	-	-	-	-	53	38463
		F	15817	39825	7990	1679	1582	1360	338	208	-	18	-	-	-	559	69376
		Total	23434	67914	10585	1679	1690	1360	338	208	-	18	-	-	-	612	107839
	70-85	M	3680	13756	-	-	-	-	-	-	-	-	-	-	-	9974	27411
		F	3487	16508	2942	-	-	587	-	-	-	-	-	-	-	22292	45816
		Total	7167	30264	2942	-	-	587	-	-	-	-	-	-	-	32266	73227
	Yearly Total	M	11297	41975	2707	31	108	-	25	-	-	-	-	-	-	10027	66173
		F	19304	56526	11316	1720	1624	1972	338	208	-	18	-	-	-	22851	115878
		Total	30601	98501	14023	1751	1732	1972	363	208	-	18	-	-	-	32878	182051
1975	43-52	M	-	16	-	26	-	-	-	-	-	-	-	-	-	17	59
		F	-	19	114	252	39	19	-	-	-	-	-	-	-	-	443
		Total	-	35	114	278	39	19	-	-	-	-	-	-	-	17	502
	53-66	M	3308	702	345	162	-	24	-	-	-	-	-	-	-	46	4588
		F	2023	1969	489	400	283	188	83	32	19	-	-	-	-	-	5488
		Total	5331	2671	834	562	283	212	83	32	19	-	-	-	-	46	10076
	70-75	M	5298	5613	170	-	-	-	-	-	-	-	-	-	-	-	11081
		F	6927	8370	1535	651	444	213	45	170	-	-	-	-	-	17	18373
		Total	12225	13983	1705	651	444	213	45	170	-	-	-	-	-	17	29454
	Yearly Total	M	8606	6331	515	188	-	24	-	-	-	-	-	-	-	63	15728
		F	8950	10358	2138	1303	766	420	128	202	19	-	-	-	-	17	24304
		Total	17556	16689	2653	1491	766	444	128	202	19	-	-	-	-	80	40032
1976	40-42	M	-	-	91	-	-	-	-	-	-	-	-	-	-	-	91
		F	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		Total	-	-	91	-	-	-	-	-	-	-	-	-	-	-	91
	53-66	M	4462	22891	994	530	-	123	-	-	-	-	-	-	-	-	29000
		F	4304	14352	2634	1297	547	191	84	119	80	-	-	-	-	7465	31073
		Total	8766	37243	3628	1827	547	314	84	119	80	-	-	-	-	7465	60073
	70-85	M	6139	6407	208	19	-	-	-	-	-	-	-	-	-	38	12811
		F	124	-	-	-	-	-	-	-	-	-	-	-	-	66	190
		Total	6263	6407	208	19	-	-	-	-	-	-	-	-	-	104	13001
	90-95	M	259	149	21	-	-	-	-	-	-	-	-	-	-	-	429
		F	284	321	114	-	-	-	-	-	-	-	-	-	-	-	719
		Total	543	470	135	-	-	-	-	-	-	-	-	-	-	-	1148
	Yearly Total	M	10860	29447	1314	549	-	123	-	-	-	-	-	-	-	38	42331
		F	4712	14673	2748	1297	547	191	84	119	80	-	-	-	-	7531	31982
		Total	15572	44120	4062	1846	547	314	84	119	80	-	-	-	-	7569	74313

YEAR	STRATA	SEX	1	2	3	4	5	6	7	8	9	10	11	12	13+	UK.	TOTAL
1977	53-66	M	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		F	4390	25683	22192	5652	2422	558	464	382	31	102	-	63	-	96	62035
		Total	4390	25683	22192	5652	2422	558	464	382	31	102	-	63	-	96	62035
	70-85	M	13279	8781	1940	1096	1235	1340	654	-	38	91	-	-	-	-	28454
		F	10447	8132	3583	1635	1737	525	203	114	38	-	-	-	-	134	26548
		Total	23726	16913	5523	2731	2972	1865	857	114	76	91	-	-	-	134	55002
	90-95	M	267	-	-	-	-	-	-	-	-	-	-	-	-	-	267
		F	275	58	-	-	-	-	-	-	-	-	-	-	-	-	332
		Total	542	58	-	-	-	-	-	-	-	-	-	-	-	-	600
	Yearly Total	M	13546	8781	1940	1096	1235	1340	654	-	38	91	-	-	-	-	28721
		F	15112	33873	25775	7287	4159	1083	667	496	69	102	-	63	-	230	88916
		Total	28658	42654	27715	8383	5394	2423	1321	496	107	193	-	63	-	230	117637
1978	70-85	M	4172	1279	501	121	34	-	-	-	-	-	43	-	-	38	6188
		F	4492	2505	794	703	768	131	81	49	88	-	-	-	-	38	9649
		Total	8664	3784	1295	824	802	131	81	49	88	-	43	-	-	76	15837
	53-66	M	1991	2575	2704	708	519	200	7	-	-	-	-	-	-	-	8704
		F	1882	2655	4041	2769	1952	1058	512	183	380	145	42	-	-	-	15619
		Total	3873	5230	6745	3477	2471	1258	519	183	380	145	42	-	-	-	24323
	43-52	M	17	1182	50	-	17	-	-	-	-	-	-	-	-	-	1266
		F	17	2020	62	91	124	66	-	-	-	-	-	-	-	35	2415
		Total	34	3202	112	91	141	66	-	-	-	-	-	-	-	35	3681
	90-95	M	375	37	-	-	21	-	-	-	-	-	-	-	-	-	433
		F	378	55	60	-	-	-	-	-	-	-	-	-	-	-	493
		Total	753	92	60	-	21	-	-	-	-	-	-	-	-	-	926
	Yearly Total	M	6555	5073	3255	829	591	200	7	-	-	-	43	-	-	38	16591
		F	6769	7235	4957	3563	2844	1255	593	232	468	145	42	-	-	73	28176
		Total	13324	12308	8212	4392	3435	1455	600	232	468	145	85	-	-	111	44767
1979	43-52	M	45	15	-	-	-	-	-	-	-	-	-	-	-	-	60
		F	150	45	31	-	25	48	15	-	-	-	-	-	-	18	332
		Total	195	60	31	-	25	48	15	-	-	-	-	-	-	18	392
	53-66	M	3650	32724	8660	1618	478	366	224	-	-	-	-	-	-	-	47720
		F	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		Total	3650	32724	8660	1618	478	366	224	-	-	-	-	-	-	-	47720
	Yearly Total	M	3695	32739	8660	1618	478	366	224	-	-	-	-	-	-	-	47780
		F	150	45	31	-	25	48	15	-	-	-	-	-	-	18	332
		Total	3845	32784	8691	1618	503	414	239	-	-	-	-	-	-	18	48112
1980	43-52	M	27	115	88	168	47	19	10	-	-	-	-	-	-	27	501
		F	27	240	71	87	194	236	27	23	-	-	-	-	-	-	905
		Total	54	355	159	255	241	255	37	23	-	-	-	-	-	27	1406
	53-66	M	2248	3562	5378	1433	596	265	46	-	-	-	-	-	-	-	13528
		F	2883	4401	8126	2153	1184	974	636	422	139	271	-	-	-	-	21189
		Total	5131	7963	13504	3586	1780	1239	682	422	139	271	-	-	-	-	34717
	70-85	M	926	1235	322	98	-	-	-	-	-	-	-	-	-	-	2581
		F	1116	1590	717	250	150	100	50	-	50	60	-	-	-	-	4083
		Total	2042	2825	1039	348	150	100	50	-	50	60	-	-	-	-	6663
	90-95	M	83	63	45	-	-	-	-	-	-	-	-	-	-	-	191
		F	72	50	-	39	-	-	-	-	-	-	-	-	-	34	195
		Total	155	113	45	39	-	-	-	-	-	-	-	-	-	34	386
	Yearly Total	M	3284	4975	5833	1699	643	284	56	-	-	-	-	-	-	27	16801
		F	4098	6281	8914	2529	1528	1310	713	445	189	331	-	-	-	34	26372
		Total	7382	11256	14747	4228	2171	1594	769	445	189	331	-	-	-	61	43173