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International Council for the
Exploration of the Sea

C.M.1988/Assess:17

PART 2

*REPORT OF THE HERRING ASSESSMENT WORKING GROUP
FOR THE AREA SOUTH OF 62⁰N*

Copenhagen, 5-15 April 1988

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Table 4.5.1 Celtic Sea. Division VIIj. Comparison between LAI from 1978-1984 and spawning stock biomass obtained from converged values from VPA.

Year	LAI	SSB
1978/1979	10.9	27.6
1979/1980	17.8	29.3
1980/1981	20.4	27.9
1981/1982	26.1	31.2
1982/1983	27.2	45.2
1983/1984	74.1	69.4
1984/1985	109.7	73.7
LAI = 0.69 SSB + 17.6 (1984/1985 value excluded)		

Table 5.1.1 Catch in weight, Division VIa (North) HERRING,
1978-1987.

Country	1978	1979	1980	1981	1982
Denmark	128	-	-	1,580	-
Faroes	-	-	-	-	74
France	1,435	3	-	1,243	2,069
German Dem. Rep.	-	-	2	-	-
Germany, Fed. Rep.	26	-	-	3,029	8,453
Iceland	-	-	256	-	-
Ireland	-	-	-	-	-
Netherlands	5,874	-	-	5,602	11,317
Norway	4,462	-	-	3,850	13,018
UK (England)	134	54	-	1,094	90
UK (Scotland)	10,097	3	33	30,389	38,381
USSR	-	-	15	-	-
Unallocated	-	-	-	4,633	18,958
Total	22,176	60	306	51,420	92,360

Country	1983	1984	1985	1986	1987 ¹
Denmark	-	96	-	-	-
Faroes	834	954	104	400	-
France	1,313	-	20	18	136
German Dem. Rep.	-	-	-	-	-
Germany, Fed. Rep.	6,283	5,564	5,937	2,188	1,711
Iceland	-	-	-	-	-
Ireland	-	-	-	6,000	6,800
Netherlands	20,200	7,729	5,500	5,160 ²	5,212 ²
Norway	7,336	6,669	4,690	4,799	4,300
UK (England)	-	-	-	-	-
UK (Scotland)	31,616	37,554	28,065	25,294	26,810
USSR	-	-	-	-	-
Unallocated	-4,059	16,588	502	37,840 ²	18,038 ²
Total	63,523	75,154	43,814	81,699	63,007

¹ Preliminary.

² Including discards.

Table 5.1.2 VIRTUAL POPULATION ANALYSIS

HERRING IN THE NORTHERN PART OF VIA

CATCH IN NUMBERS		UNIT: thousands										

	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981
1	238738	169947	801663	51170	309016	172879	69053	34836	22525	392	12867	36740
2	205454	372615	804097	235627	124944	202087	319604	47739	46284	225	1335	77961
3	359711	560348	219502	808267	151025	89066	101548	95834	20587	122	452	105600
4	139718	357745	63069	131484	519178	63701	35502	22117	40692	31	246	61341
5	53320	113391	85920	63071	82466	188202	25195	10083	6879	21	62	21473
6	203462	54571	37341	54642	49683	30601	76289	12211	3833	12	43	12623
7	29141	181592	13377	18242	34629	12297	10918	20992	2100	7	40	11583
8	32860	18042	100938	6506	22470	13121	3914	2758	6278	2	3	1309
9+	30651	36395	20465	32223	21042	13698	12014	1486	1544	0	1	1326
TOTAL	1293055	1864646	2146372	1401232	1314453	785652	654037	248056	150722	812	15049	329956
	1982	1983	1984	1985	1986	1987						
1	13304	81923	2961	45663	38943	27645						
2	250010	77810	253291	77063	178714	93679						
3	72179	92743	66857	166112	99264	64575						
4	93544	29262	46963	19269	137077	45488						
5	58452	42535	20057	17027	21723	71188						
6	23580	27318	15250	7422	20759	11973						
7	11516	14709	12478	7731	2973	10378						
8	13814	8437	5940	3720	16177	4982						
9+	4027	8484	2629	2450	2273	8498						
TOTAL	540426	383221	426426	346457	517903	338406						

Table 5.1.3 HERRING in Division VIa (North). Larvae abundance indices (numbers in billions), larvae mortality rates (Z/K), fecundity estimate (10^5 eggs/kg), spawning stock biomass ('000 t, age 2+ at spawning time).

Year	LAI	Z/K	LPE			Spawning stock biomass from		
			Larvae	Fecundity	SSB	LPE ¹	LAI ²	VPA
1973	2,442	0.74	318	(1.39)	229	174	322	423
1974	1,186	0.42	238	(1.39)	171	130	157	221
1975	878	0.46	157	1.46	108	82	116	126
1976	189	-	60	1.23	49	37	25	103
1977	787	-	223	1.49	150	114	104	71
1978	332	-	132	1.37	109	83	44	73
1979	1,071	-	118	1.49	79	60	141	110
1980	1,436	0.39	287	2.04	141	107	190	194
1981	2,154	0.34	448	2.12	211	160	284	201
1982	1,890	0.39	267	1.95	137	104	249	204
1983	668	-	112	1.88	60	46	88	183
1984	2,133	0.57	253	1.75	145	110	282	320
1985	2,710	0.37	418	(1.86)	225	171	358	348
1986	3,037	0.24	907	(1.86)	488	371	401	359
1987	4,119	0.53	423	(1.86)	227	173	544	367

¹ Predicted from (1973-1986) regression:
SSB = 0.76 x LPE (r = 0.65).

² Predicted from (1973-1986) regression:
SSB = 0.132 x LAI (r = 0.87).

Table 5.1.4 HERRING in Division VIa (North). Scottish bottom trawl survey indices of 2-ringed herring catch rates in January-March and acoustic survey indices of the same year class in the preceding November.

Trawl survey year	Year class	Number of GOV hauls	2-ringer index (millions)	Acoustic estimate no. of 1-ringers (millions)
1981	1978	9	1,237	-
1982	1979	10	2,361	-
1983	1980	12	11	-
1984	1981	12	12,456	28.1
1985	1982	17	98	-
1986	1983	12	359	1,039.0
1987	1984	15	40	85.6
1988	1985	19	15,500 ¹	249.1

¹Preliminary estimate.

Table 5.1.5 HERRING in Division VIa (North). Mean weights at age (kg).

Age (rings)	Weight in the stock	Weight in the catch			
		1982-1984	1985	1986	1987
1	0.090	0.090	0.069	0.113	0.073
2	0.164	0.140	0.103	0.145	0.143
3	0.208	0.175	0.134	0.173	0.183
4	0.233	0.205	0.161	0.196	0.211
5	0.246	0.231	0.182	0.215	0.220
6	0.252	0.253	0.199	0.230	0.238
7	0.258	0.270	0.213	0.242	0.241
8	0.269	0.284	0.223	0.251	0.253
9	0.292	0.295	0.231	0.258	0.256

Table 5.1.6 HERRING IN THE NORTHERN PART OF VIA
 At 08.26.39 21 APRIL 1988
 from 70 to 87 on ages 2 to 8
 with Terminal F of .170 on age 3 and Terminal S of 1.000
 Initial sum of squared residuals was 435.691 and
 final sum of squared residuals is 19.174 after 84 iterations

Matrix of Residuals

Years	70/71	71/72	72/73	73/74	74/75	75/76	76/77					
Ages												
2/ 3	-.901	-.707	-.315	.161	-.523	-.163	.100					
3/ 4	-.096	.632	-.014	-.059	-.249	-.183	.157					
4/ 5	.282	.136	-.349	.151	.111	.034	.104					
5/ 6	-.010	-.250	.036	-.134	.033	-.044	-.491					
6/ 7	.242	.181	.418	.208	.579	.226	.219					
7/ 8	.762	-.454	.595	-.308	.302	.486	.467					
	.000	.000	.000	.000	.000	.000	.000					
WTS	.001	.001	.001	.001	.001	.001	.001					
Years	77/78	78/79	79/80	80/81	81/82	82/83	83/84	84/85	85/86	86/87	WTS	
Ages												
2/ 3	-.160	-.563	-.150	.528	.126	.311	-.451	-.455	-.164	.472	.000	.497
3/ 4	-.389	-.244	-.350	-.196	-.034	-.002	-.140	.152	.081	.025	.000	.817
4/ 5	.117	1.005	-.195	.393	.059	.061	-.271	.088	-.074	.062	.000	.686
5/ 6	-.153	-.303	-.310	-.534	-.155	-.042	.298	-.017	-.234	-.082	.000	1.000
6/ 7	.771	-.230	-.702	-.718	.141	-.212	.170	-.222	.982	.121	.000	.452
7/ 8	.398	.644	1.572	1.585	.053	-.184	.488	.517	-.469	-.881	.000	.307
	.000	.000	-.640	.000	.000	.000	.000	.000	.000	.000	3.363	
WTS	.001	.001	.001	.001	1.000	1.000	1.000	1.000	.001	1.000		
Fishing Mortalities (F)												
	70	71	72	73	74	75	76	77				
F-values	.4061	.8300	.4637	.5795	.8971	.9114	.9601	.7314				
	78	79	80	81	82	83	84	85	86	87		
F-values	.5015	.0010	.0018	.3017	.4797	.3817	.3030	.1655	.2304	.1700		
Selection-at-age (S)												
	2	3	4	5	6	7	8					
S-values	.8249	1.0000	.9014	.8940	.8084	.8044	1.0000					

Table 5.1.7 VIRTUAL POPULATION ANALYSIS

HERRING IN THE NORTHERN PART OF VIA		FISHING MORTALITY COEFFICIENT UNIT: Year-1										VARIABLE NATURAL MORTALITY COEFFICIENT	
		1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981
2		.181	.424	.295	.500	.489	.730	.732	.301	.248	.001	.002	.261
3		.416	1.154	.512	.585	.765	.860	1.186	.545	.218	.001	.002	.279
4		.444	.908	.341	.630	.905	.838	1.009	.876	.446	.000	.002	.341
5		.443	.695	.500	.593	.933	.890	.852	.793	.658	.000	.001	.245
6		.320	.987	.456	.609	1.210	.999	1.028	1.265	.712	.002	.001	.239
7		.637	.465	.612	.374	.881	1.035	1.125	.791	.665	.002	.007	.244
8		.406	.936	.452	.604	.953	.897	1.019	.872	.510	.001	.001	.277
9+		.406	.936	.452	.604	.953	.897	1.019	.872	.510	.001	.001	.277
(3-6)U		.406	.936	.452	.604	.953	.897	1.019	.870	.509	.001	.001	.276
		1982	1983	1984	1985	1986	1987						
2		.492	.236	.195	.128	.289	.170						
3		.439	.364	.349	.201	.257	.170						
4		.404	.302	.301	.152	.241	.170						
5		.558	.288	.311	.152	.228	.170						
6		.411	.488	.142	.162	.249	.170						
7		.318	.432	.383	.090	.081	.170						
8		.453	.361	.276	.167	.244	.170						
9+		.453	.361	.276	.167	.244	.170						
(3-6)U		.453	.361	.276	.167	.244	.170						

Table 5.1.8 VIRTUAL POPULATION ANALYSIS

HERRING IN THE NORTHERN PART OF VIA
 STOCK SIZE IN NUMBERS UNIT: thousands

 BIOMASS TOTALS UNIT: tonnes

ALL VALUES, EXCEPT THOSE REFERRING TO THE SPAWNING STOCK ARE GIVEN FOR 1 JANUARY; THE SPAWNING
 STOCK DATA REFLECT THE STOCK SITUATION AT SPAWNING TIME, WHEREBY THE FOLLOWING VALUES ARE
 USED: PROPORTION OF ANNUAL F BEFORE SPAWNING: .670
 PROPORTION OF ANNUAL M BEFORE SPAWNING: .670

	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981
2	1433313	1235956	3615998	684640	369702	443325	699830	210835	242396	367405	643885	390132
3	1158187	886437	599446	1994334	307633	168031	158223	249284	115561	140128	271987	475857
4	407641	625538	228943	294173	909717	117148	58241	39555	118303	76083	114617	222276
5	156029	236489	228377	147356	141809	333149	45847	19218	14912	68497	68814	103476
6	778243	90668	106785	125286	73656	50499	123801	17695	7865	6987	61959	62206
7	64672	511241	30569	61252	61669	19868	16834	40089	4519	3493	6311	56022
8	103132	30954	290591	15004	38132	23112	6383	4945	16444	2103	3154	5672
9+	96199	62442	58917	74314	35708	24128	19592	2664	4044	0	1051	5746
TOTAL NO	4197416	3679726	5159626	3396358	1938024	1179260	1128749	584286	524043	664696	1171778	1321387
SPS NO	2965575	2016847	3456297	2030519	1013203	596722	542732	356476	367134	569769	1002441	963405
TOT. BIOM	877965	772311	957402	705005	426624	248020	215509	117282	103774	127206	224202	273539
SPS BIOM	620385	422248	642035	422876	221031	125712	102973	70551	72596	110078	193597	200904
	1982	1983	1984	1985	1986	1987	1988					
2	735762	425225	1646002	739517	818822	690657	0					
3	222599	333282	248684	1003247	481977	454450	431662					
4	294650	117519	189595	143561	671836	305323	313904					
5	142964	177963	78583	127010	111601	477825	233077					
6	73253	74037	120681	52083	98754	80365	364762					
7	44308	43938	41122	94714	40079	69659	61349					
8	39699	29171	25821	25381	78355	33440	53176					
9+	11573	29333	11428	16716	11010	57040	69071					
TOTAL NO	1564809	1230468	2361915	2202228	2312433	2168759						
SPS NO	1000984	875818	1719343	1712889	1715765	1713010						
TOT. BIOM	314738	256626	436481	443920	478048	460353						
SPS BIOM	204217	183417	319509	347528	359110	367207						

Table 5.1.9
List of input variables for the ICES prediction program.

HERRING - VIA NORTH

The reference F is the mean F for the age group range from 3 to 6

The number of recruits per year is as follows:

Year	Recruitment
1988	506000.0
1989	506000.0
1990	506000.0

Proportion of F (fishing mortality) effective before spawning: .6700

Proportion of M (natural mortality) effective before spawning: .6700

Data are printed in the following units:

Number of fish: thousands
Weight by age group in the catch: kilogram
Weight by age group in the stock: kilogram
Stock biomass: tonnes
Catch weight: tonnes

age	stock size	fishing pattern	natural mortality	maturity ogive	weight in the catch	weight in the stock
2	506000.0	1.00	.30	1.00	.143	.164
3	431662.0	1.00	.20	1.00	.183	.208
4	313904.0	1.00	.10	1.00	.211	.233
5	233077.0	1.00	.10	1.00	.220	.246
6	364762.0	1.00	.10	1.00	.238	.252
7	61349.0	1.00	.10	1.00	.241	.258
8	53176.0	1.00	.10	1.00	.253	.269
9+	69071.0	1.00	.10	1.00	.256	.292

Table 5.1.10 HERRING - VIA NORTH

 * Year 1988, F-factor .144 and reference F .1440 *
 * Run depending on a TAC value *

						at 1 January	at spawning time			
age	absolute F	catch in numbers	catch in weight	stock size	stock biomass	sp. stock size	sp. stock biomass	sp. stock size	sp. stock biomass	
2	.1440	58821	8411.4	506000	82984	506000	82984	375811	61633	
3	.1440	52579	9622.1	431662	89785	431662	89785	342815	71305	
4	.1440	40098	8460.7	313904	73139	313904	73139	266570	62110	
5	.1440	29773	6550.1	233077	57336	233077	57336	197931	48691	
6	.1440	46594	11089.6	364762	91920	364762	91920	309759	78059	
7	.1440	7836	1888.7	61349	15828	61349	15828	52098	13441	
8	.1440	6792	1718.6	53176	14304	53176	14304	45157	12147	
9+	.1440	8823	2258.7	69071	20168	69071	20168	58655	17127	
Total		251320	50000.0	2033001	445467	2033001	445467	1648798	364516	

 * Year 1989, F-factor .170 and reference F .1700 *

						at 1 January	at spawning time			
age	absolute F	catch in numbers	catch in weight	stock size	stock biomass	sp. stock size	sp. stock biomass	sp. stock size	sp. stock biomass	
2	.1700	68632	9814.5	506000	82984	506000	82984	369310	60566	
3	.1700	46123	8440.6	324596	67516	324596	67516	253327	52692	
4	.1700	45593	9620.2	306031	71305	306031	71305	255389	59505	
5	.1700	36642	8061.4	245951	60503	245951	60503	205250	50491	
6	.1700	27207	6475.4	182621	46020	182621	46020	152400	38405	
7	.1700	42579	10261.6	285799	73736	285799	73736	238504	61534	
8	.1700	7161	1811.8	48068	12930	48068	12930	40113	10790	
9+	.1700	14270	3653.1	95783	27968	95783	27968	79932	23340	
Total		288210	58138.7	1994850	442965	1994850	442965	1594229	357326	

 * Year 1990, F-factor .170 and reference F .1700 *

						at 1 January	at spawning time			
age	absolute F	catch in numbers	catch in weight	stock size	stock biomass	sp. stock size	sp. stock biomass	sp. stock size	sp. stock biomass	
2	.1700	68632	9814.5	506000	82984	506000	82984	369310	60566	
3	.1700	44937	8223.6	316251	65780	316251	65780	246814	51337	
4	.1700	33403	7048.1	224209	52240	224209	52240	187107	43595	
5	.1700	34805	7657.1	233618	57470	233618	57470	194958	47959	
6	.1700	27972	6657.4	187753	47313	187753	47313	156684	39484	
7	.1700	20769	5005.5	139409	35967	139409	35967	116339	30015	
8	.1700	32504	8223.6	218173	58688	218173	58688	182069	48976	
9+	.1700	16360	4188.3	109813	32065	109813	32065	91641	26759	
Total		279385	56818.0	1935229	432510	1935229	432510	1544925	348696	

Table 5.2.1 Monthly landings (tonnes) of HERRING from the Firth of Clyde (all fishing methods combined). (Data provided by Working Group.)

Month	1976	1977	1978	1979	1980	1981
January	- ¹	- ¹	4 ¹	4 ¹	6 ¹	15 ¹
February	7 ¹	- ¹	6 ¹	8 ¹	3 ¹	15 ¹
March	69 ¹	- ¹	7 ¹	13 ¹	8 ¹	14 ¹
April	521	530	246	12 ¹	4 ¹	32 ¹
May	436	44	245	4 ¹	2 ¹	25 ¹
June	281	640	238	336	114	429
July	332	494	376	466	656	982
August	473	601	587	450	645	511
September	541	559	581	374	559	106
October	598	556	653	263	79	- ¹
November	595	560	647	1 ¹	3 ¹	2 ¹
December	236	328	272	- ¹	2 ¹	4 ¹
Not known	50	35	-	-	-	-
Total	4,139	4,847	3,862	1,951	2,081	2,135

Month	1982	1983	1984	1985	1986	1987
January	2 ¹	+ ¹	- ¹	- ¹	- ¹	- ¹
February	16 ¹	1 ¹	- ¹	- ¹	- ¹	- ¹
March	1 ¹	1 ¹	- ¹	- ¹	- ¹	- ¹
April	2 ¹	- ¹	- ¹	- ¹	- ¹	+ ¹
May	615	1 ¹	554	527	272 ¹	112 ¹
June	850	265	847	831	724	289
July	757	519	944	815	763	189
August	262	681	276	661	786	323
September	- ¹	604	246	187	555	961
October	- ¹	457	124	1 ¹	218 ¹	571
November	- ¹	1 ¹	- ¹	- ¹	77 ¹	379
December	1 ¹	- ¹	- ¹	- ¹	- ¹	71
Not known	-	273 ²	247 ²	-	-	-
Total	2,506	2,803	3,238	3,022	3,395	2,895

¹ Subject to closure of directed fishery for whole or part of the month.

² Landed in Northern Ireland and Isle of Man.

+ Less than 1 t.

Table 5.2.2 Monthly landings of Clyde herring in number at age (thousands) in landings and discards, 1987.

Age (rings)	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total landings	Estimated discards ¹	Estimated catch
0	-	-	-	-	-	-	-	-	-	-	-
1	-	8	-	-	60	52	-	-	162	346	508
2	3	6	50	57	206	237	148	46	753	623	1,376
3	125	162	171	233	825	1,022	373	72	2,983	686	3,669
4	151	274	344	290	1,154	811	552	136	3,712	667	4,379
5	124	272	280	362	1,094	604	407	68	3,211	197	3,408
6	90	253	159	258	657	226	219	35	1,897	86	1,983
7	47	226	109	126	554	107	162	17	1,398	29	1,427
8	19	148	27	137	234	46	53	4	668	12	680
9	21	30	8	54	144	16	31	1	305	3	308
>10	8	28	-	45	57	30	5	+	173	2	175

¹ Assuming percentage of each age discarded the same as in 1986.

Table 5.2.3 Number of days absent from port by pair trawlers in the Firth of Clyde, 1974-1987.

Year	Days absent
1974	3,376
1975	3,209
1976	3,016
1977	4,186
1978	4,379
1979	2,933
1980	1,982
1981	1,529
1982	1,755
1983	1,644
1984	1,401
1985	1,688
1986	1,375 ¹
1987	998 ¹

¹ Days absence by herring pair trawlers (850) raised to account for landings by other vessels.

Table 5.2.4 Weights at age (g) of Clyde herring by month in landings and catch.

Age (rings)	May			Jun			Jul			Aug		
	1985 catch	1986 catch	1987 landings	1985 catch	1986 catch	1987 landings	1985 catch	1986 catch	1987 landings	1985 catch	1986 catch	1987 landings
1	61	72	-	91	53	39	-	101	-	128	114	-
2	126	119	171	146	149	129	170	181	145	160	198	182
3	162	156	197	180	186	192	204	207	187	201	215	193
4	198	194	212	225	211	210	251	219	180	243	247	196
5	206	204	221	248	240	216	260	261	189	268	268	206
6	218	219	225	269	252	222	282	268	196	285	295	215
7	245	245	240	315	291	234	311	295	201	325	308	230
8	238	246	238	277	316	247	321	297	228	306	362	236
9	253	261	243	288	277	256	318	308	227	340	321	237
>10	262	287	251	310	322	260	283	322	-	363	322	232

Age (rings)	Sep			Oct		Nov	Dec	Whole year		
	1985 catch	1986 catch	1987 landings	1986 landings	1987 landings	1987 landings	1987 landings	1985 catch	1986 catch	1987 landings
1	119	121	71	103	70	-	81	65	76	72
2	176	202	146	175	145	152	146	149	166	149
3	207	228	193	192	195	200	190	187	199	194
4	254	255	204	217	202	214	201	228	224	203
5	260	279	217	234	227	230	216	23	253	217
6	306	283	222	270	247	247	233	272	265	225
7	313	326	239	220	259	239	248	307	297	236
8	300	346	247	304	274	260	242	291	298	247
9	272	334	259	-	247	285	312	300	298	255
>10	330	341	261	-	271	366	286	300	321	258

Table 5.2.5 Estimated number (thousands) of Clyde herring (2-ringers and older) at each maturity stage in commercial landings in each month of 1987.

Month	Maturity stage						
	II	III	IV	V	VI	VII	VIII
May	+	28	+	-	-	-	531
June	19	465	36	-	-	-	748
July	56	579	151	-	-	-	239
August	12	480	657	23	-	-	264
September	29	1,811	1,926	171	-	-	525
October	22	732	1,671	44	14	-	386
November	13	375	642	167	-	16	383
December	2	14	50	-	-	-	24

Table 5.2.6 Estimated biomass (tonnes) and numbers at age (millions) of Clyde herring from the acoustic survey in July 1987.

Age (rings)	Millions
1	148.2
2	11.5
3	9.2
4	11.5
5	5.7
6	3.0
7	1.2
8	0.7
>9	0.4
Biomass (t) <22 cm	7,400
>22 cm	8,700
Total	16,100

Table 5.2.7 Estimates of Clyde herring biomass by acoustic surveys and VPA.

Year	Acoustic survey dates	Biomass estimates ('000 t)		
		Acoustic survey		VPA ¹
		1-ringers and older	2-ringers and older	2-ringers and older
1985	17 - 25 May	2.2	2.2	25.2
	26 May - 1 June	10.9	10.8	
1986	30 May - 2 June	12.5	12.4	22.9
	4 - 9 June	5.6	5.6	
1987	8 - 14 July	16.1	8.7	(19.8 projected)

¹ Estimated biomass on 1 January (Anon., 1987).

Table 5.2.8 CLYDE HERRING

At 11.46.32 21 APRIL 1988

from 70 to 87 on ages 2 to 9

with Terminal F of .110 on age 3 and Terminal S of 1.000

Initial sum of squared residuals was 42.817 and

final sum of squared residuals is 16.060 after 106 iterations

Matrix of Residuals

Years	70/71	71/72	72/73	73/74	74/75	75/76	76/77					
Ages												
2/3	.424	.064	-.023	-.149	.298	.043	.320					
3/4	.057	-.381	-.031	-.087	-.158	.307	-.121					
4/5	.000	-.294	-.112	-.325	-.114	-.016	-.147					
5/6	.000	.640	-.141	.013	-.125	.012	-.007					
6/7	-.478	-.093	-.129	.055	.117	-.074	.236					
7/8	-.119	.188	.320	.453	-.013	-.151	.226					
8/9	-.132	-.110	-.094	.339	-.448	-.106	-.260					
	.000	.000	.000	.000	.000	.000	.000					
WTS	.001	.001	.001	.001	.001	.001	.001					
Years	77/78	78/79	79/80	80/81	81/82	82/83	83/84	84/85	85/86	86/87	WTS	
Ages												
2/3	.514	-.126	-.071	1.101	-1.271	.038	.117	.984	-1.108	-.031	.000	.304
3/4	.368	.084	-.703	.504	-.469	.246	.118	.359	-.615	-.108	.000	.513
4/5	-.182	.187	-.185	-.313	-.274	.199	-.293	.198	-.160	.058	.000	1.000
5/6	.087	-.134	.458	.327	.001	.057	.224	-.394	-.110	.222	.000	.764
6/7	-.082	-.131	-.124	-.410	.423	-.204	-.254	-.385	.775	.068	.000	.581
7/8	.084	.113	.913	-.494	.352	-.695	-.038	-.033	.765	-.002	.000	.461
8/9	-.458	-.137	-.275	-.134	1.024	.123	.395	-.295	.195	-.418	.000	.481
	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	1.598	
WTS	.001	.001	.001	.001	.001	1.000	1.000	1.000	1.000	1.000		
Fishing Mortalities (F)												
	70	71	72	73	74	75	76	77				
F-values	.5723	.4770	.4968	.4954	.4520	.3095	.2576	.4023				
	78	79	80	81	82	83	84	85	86	87		
F-values	.3653	.2425	.1093	.2375	.1738	.1195	.1060	.1484	.1030	.1100		
Selection-at-age (S)												
	2	3	4	5	6	7	8	9				
S-values	.9608	1.0000	1.0810	.9754	1.0385	.9907	1.2154	1.0000				

Table 5.2.9 SUM OF PRODUCTS CHECK

CLYDE HERRING
CATEGORY: TOTAL

CATCH IN NUMBERS		UNIT: thousands											
-----		1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981
2	7551	6503	8983	5258	8841	1876	10480	7524	1796	4859	5633	2372	
3	10338	1976	3181	4548	2817	2483	913	6976	2259	807	1592	2785	
4	8745	4355	1684	1811	2559	1024	1049	1062	2724	930	567	1622	
5	2306	3432	3007	918	1140	1072	526	1112	634	888	341	1158	
6	741	1090	1114	1525	494	451	638	574	606	341	204	433	
7	760	501	656	659	700	175	261	489	330	289	125	486	
8	753	352	282	307	253	356	138	251	298	156	48	407	
9	227	225	177	132	87	130	178	146	174	119	56	74	
10+	117	181	132	114	59	67	100	192	236	154	68	18	
TOTAL	31538	18615	19216	15272	16950	7634	14283	18326	9057	8543	8634	9355	
	1982	1983	1984	1985	1986	1987							
2	11311	10109	11829	2951	4574	1376							
3	4079	5232	5774	4420	4431	3669							
4	2440	1747	3406	4592	4622	4379							
5	1028	963	1509	2806	2679	3408							
6	663	555	587	2654	1847	1983							
7	145	415	489	917	644	1427							
8	222	189	375	681	287	680							
9	63	85	74	457	251	308							
10+	53	38	80	240	79	175							
TOTAL	20004	19333	24122	19718	19414	17405							

Table 5.2.10 VIRTUAL POPULATION ANALYSIS

CLYDE HERRING		UNIT: Year-1					VARIABLE NATURAL MORTALITY COEFFICIENT						
FISHING MORTALITY COEFFICIENT		1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981
2	.593	.431	.452	.441	.664	.250	.453	.646	.114	.264	.251	.080	
3	.541	.322	.416	.467	.483	.422	.197	.674	.437	.072	.137	.200	
4	.792	.437	.472	.419	.496	.307	.300	.349	.579	.306	.063	.191	
5	.605	.743	.540	.452	.450	.353	.228	.525	.322	.333	.157	.160	
6	.437	.569	.505	.514	.416	.286	.327	.369	.537	.256	.106	.272	
7	.592	.526	.712	.560	.417	.226	.238	.396	.333	.470	.126	.348	
8	.764	.533	.562	.769	.384	.344	.250	.336	.397	.232	.117	.657	
9	.572	.477	.497	.495	.452	.309	.258	.402	.365	.243	.109	.237	
10+	.572	.477	.497	.495	.452	.309	.258	.402	.365	.243	.109	.237	
(2-6)U	.594	.500	.477	.459	.502	.324	.301	.512	.398	.246	.143	.180	
	1982	1983	1984	1985	1986	1987							
2	.212	.176	.160	.045	.096	.106							
3	.202	.152	.153	.087	.093	.110							
4	.257	.119	.133	.166	.118	.119							
5	.159	.137	.128	.138	.124	.107							
6	.116	.109	.104	.308	.114	.114							
7	.123	.089	.119	.210	.102	.109							
8	.236	.209	.098	.215	.084	.134							
9	.174	.120	.106	.148	.103	.110							
10+	.174	.120	.106	.148	.103	.110							
(2-6)U	.189	.138	.136	.149	.109	.111							

Table 5.2.11 VIRTUAL POPULATION ANALYSIS

CLYDE HERRING

STOCK SIZE IN NUMBERS UNIT: thousands

BIOMASS TOTALS UNIT: tonnes

ALL VALUES, EXCEPT THOSE REFERRING TO THE SPAWNING STOCK ARE GIVEN FOR 1 JANUARY; THE SPAWNING STOCK DATA REFLECT THE STOCK SITUATION AT SPAWNING TIME, WHEREBY THE FOLLOWING VALUES ARE USED: PROPORTION OF ANNUAL F BEFORE SPAWNING: .900
PROPORTION OF ANNUAL M BEFORE SPAWNING: .670

	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981
2	19259	21281	28295	16884	20744	9743	32953	18013	19265	24113	29236	35840
3	27044	7887	10249	13344	8048	7910	5619	15526	6995	12736	13724	16858
4	16685	12887	4682	5537	6848	4065	4249	3779	6480	3701	9700	9802
5	5315	6836	7534	2641	3294	3774	2707	2849	2412	3285	2467	8238
6	2193	2627	2942	3971	1520	1901	2398	1950	1525	1581	2131	1908
7	1780	1282	1346	1607	2149	907	1292	1565	1220	807	1107	1734
8	1472	891	686	597	831	1281	655	921	953	791	456	883
9	545	621	473	354	250	512	822	462	596	580	568	367
10+	281	499	353	305	170	264	462	607	808	750	690	89
TOTAL NO	74573	54811	56558	45241	43855	30357	51157	45673	40254	48345	60078	75719
SPS NO	37818	31804	32064	26067	23213	20043	31236	23551	26932	34168	44457	57378
TOT. BIOM	20243	14771	14775	12112	11511	8322	12904	12088	10585	12487	15534	19692
SPS BIOM	10301	8580	8410	7009	6227	5524	8048	6357	7004	8897	11680	14911
	1982	1983	1984	1985	1986	1987	1988	1970-87				
2	68257	72130	92290	77605	57644	15838	0	36633				
3	24521	40918	44805	58268	54964	38791	10556	22678				
4	11295	16404	28786	31481	43719	41004	28451	14506				
5	7329	7905	13183	22811	24125	35168	32942	8993				
6	6354	5655	6238	10496	17976	19284	28584	5147				
7	1316	5120	4590	5087	6980	14511	15566	3022				
8	1108	1053	4238	3689	3732	5704	11774	1663				
9	414	792	773	3478	2692	3104	4515	967				
10+	349	354	833	1827	847	1764	3946	625				
TOTAL NO	120943	150330	195737	214742	212678	175168						
SPS NO	86248	112885	148561	170820	171787	144252						
TOT. BIOM	24780	31368	41359	47106	48716	36260						
SPS BIOM	17912	23900	31833	37447	39690	29979						

Table 6.1.1 Estimated HERRING catches in tonnes in Divisions VIa (South) and VIIb,c, 1978-1987.

Country	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987 ¹
France	-	-	-	-	353	19	-	-	-	-
Germany Fed.Rep.	100	5	-	2,687	265	-	-	-	-	-
Ireland	19,128	18,910	27,499	19,443	16,856	15,000	10,000	13,900	15,450	15,000
Netherlands	481	1,939	1,514	2,790	1,735	5,000	6,400	1,270	1,550	1,550
UK (N. Ireland)	6	2	1	2	-	-	-	-	-	5
UK (Eng. + Wales)	-	-	-	-	-	-	-	-	-	51
Unallocated	-	1,752	1,110	-	-	13,000	11,000	8,204	11,785	18,465
Total	19,715	22,608	30,124	24,922	19,209	33,019	27,400	23,374	28,785	35,071

¹ Provisional.

Table 6.1.2 SUM OF PRODUCTS CHECK

HERRING IN FISHING AREAS VIIB,C AND LOWER VIA (W. COAST OF IRELAND, PORCUPINE BANK)
 CATEGORY: TOTAL

CATCH IN NUMBERS		UNIT: thousands											
-----		1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981
1	135	883	1001	6423	3374	7360	16613	4485	10170	5919	2856	1620	
2	35114	6177	28786	40390	29406	41308	29011	44512	40320	50071	40058	22265	
3	26007	7038	20534	47389	41116	25117	37512	13396	27079	19161	64946	41794	
4	13243	10856	6191	16863	44579	29192	26544	17176	13308	19969	25140	31460	
5	3895	8826	11145	7432	17857	23718	25317	12209	10685	9349	22126	12812	
6	40181	3938	10057	12383	8882	10703	15000	9924	5356	8422	7748	12746	
7	2982	40553	4243	9191	10901	5909	5208	5534	4270	5443	6946	3461	
8	1667	2286	47182	1969	10272	9378	3596	1360	3638	4423	4344	2735	
9+	1911	2160	4305	50980	30549	32029	15703	4150	3324	4090	5334	5220	
TOTAL	125135	82717	133444	193020	196936	184714	174504	112746	118150	126847	179498	134113	
CATCH	20306	15044	23474	36719	36589	38764	32767	20567	19715	22608	30124	24922	
C/SOP(%)	90	87	90	102	98	112	105	108	102	107	96	103	
		1982	1983	1984	1985	1986	1987						
1	748	1517	2794	9606	918	9305							
2	18136	43688	81481	15143	27110	32663							
3	17004	49534	28660	67355	24818	52594							
4	28220	25316	17854	12756	66383	27731							
5	18280	31782	7190	11241	14644	64952							
6	8121	18320	12836	7638	7988	10375							
7	4089	6695	5974	9185	5696	8934							
8	3249	3329	2008	7587	5422	4297							
9+	2875	4251	4020	2168	2127	7472							
TOTAL	100722	184432	162817	142679	155106	218323							
CATCH	19209	32988	27450	23343	28785	35071							
C/SOP(%)	103	100	97	98	100	100							

Table 6.3.1 Larvae production estimates (LPE) and larvae abundance indices (LAI) for Divisions VIa (South) and VIb,c. SSB is calculated as LPE/fecundity.

Year	LAI(10^{11})	LPE(10^{11})	Fecundity (eggs/kg)	SSB ('000 tonnes)
1981	58	254	1.42	179
1982	76	198	1.44	138
1983	68	192	1.41	136
1984	36	81	(1.43)	57
1985	26	84	(1.43)	59
1986	62 ¹	124	(1.43)	87
1987	40	112	(1.43)	78

¹No survey in September.

Table 6.4.1 HERRING IN FISHING AREAS VIIIB,C AND LOWER VIA (W. COAST OF IRELAND, PORCUPINE BANK)

At 12.42.39 21 APRIL 1988

from 77 to 87 on ages 2 to 8

with Terminal F of .350 on age 3 and Terminal S of 1.000

Initial sum of squared residuals was 16.218 and
 final sum of squared residuals is 5.070 after 92 iterations

Matrix of Residuals

Years	77/78	78/79	79/80	80/81	81/82	82/83	83/84	84/85	85/86	86/87		WTS
Ages												
2/ 3	.552	1.036	.322	-.084	.322	-.295	-.032	.431	-.013	-.094	.000	.292
3/ 4	-.521	.027	-.268	.077	-.138	-.265	-.046	.492	-.062	-.118	.000	.436
4/ 5	-.084	.046	-.130	-.009	-.019	-.017	.157	.119	-.242	-.016	.000	1.000
5/ 6	.257	-.077	.151	-.142	-.115	.090	-.206	-.412	.230	.297	.000	.497
6/ 7	.215	-.392	.098	.051	.505	.228	-.055	-.078	.122	-.217	.000	.461
7/ 8	-.240	-.442	.104	.150	-.599	.216	.000	-.686	.323	.149	.000	.319
WTS	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.651	
	.001	.001	.001	.001	.001	1.000	1.000	1.000	1.000	1.000		

Fishing Mortalities (F)

	77	78	79	80	81	82	83	84	85	86	87
F-values	.2891	.2397	.2496	.3675	.2889	.2387	.4052	.2052	.1962	.2432	.3500

Selection-at-age (S)

	2	3	4	5	6	7	8
S-values	.5038	1.0000	1.0945	1.1198	1.1429	1.0954	1.0000

Table 6.4.2 VIRTUAL POPULATION ANALYSIS

HERRING IN FISHING AREAS VIIB,C AND LOWER VIA (W. COAST OF IRELAND, PORCUPINE BANK)

	FISHING MORTALITY COEFFICIENT					VARIABLE NATURAL MORTALITY COEFFICIENT				
	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987
2	.263	.161	.153	.158	.096	.275	.146	.089	.112	.176
3	.254	.204	.345	.251	.185	.434	.311	.183	.219	.350
4	.256	.285	.423	.265	.255	.433	.260	.210	.263	.383
5	.294	.257	.516	.352	.217	.447	.187	.232	.352	.392
6	.217	.353	.312	.563	.351	.312	.290	.276	.229	.400
7	.188	.318	.488	.199	.312	.482	.142	.309	.303	.383
8	.230	.270	.400	.320	.260	.400	.230	.240	.270	.350
9+	.230	.270	.400	.320	.260	.400	.230	.240	.270	.350
(2-7)U	.245	.263	.373	.298	.236	.397	.223	.217	.246	.347
(3-7)U	.242	.283	.417	.326	.264	.421	.238	.242	.273	.382

Table 6.4.3 VIRTUAL POPULATION ANALYSIS

HERRING IN FISHING AREAS VIIIB,C AND LOWER VIA (W. COAST OF IRELAND, PORCUPINE BANK)

STOCK SIZE IN NUMBERS UNIT: thousands

BIOMASS TOTALS UNIT: tonnes-----
ALL VALUES, EXCEPT THOSE REFERRING TO THE SPAWNING STOCK ARE GIVEN FOR 1 JANUARY; THE SPAWNING STOCK DATA REFLECT THE STOCK SITUATION AT SPAWNING TIME, WHEREBY THE FOLLOWING VALUES AREUSED: PROPORTION OF ANNUAL F BEFORE SPAWNING: .670
PROPORTION OF ANNUAL M BEFORE SPAWNING: .670

	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988
2	200611	387566	325206	175279	228862	209081	690990	204833	295003	233245	0
3	132797	114267	244353	206701	110833	154031	117684	442283	138788	195361	144907
4	61808	84366	76304	141726	131636	75429	81685	70596	301452	91293	112714
5	43961	43299	57396	45223	98391	92334	44266	56972	51770	209784	56321
6	28778	29643	30308	30985	28773	71678	53440	33228	40883	32960	128262
7	26140	20956	18837	20076	15974	18335	47483	36179	22820	29411	19991
8	18571	19599	13800	10467	14880	10576	10250	37291	24025	15246	18145
9+	16968	18123	16945	19977	13167	13505	20520	10656	9425	26511	26625
TOTAL NO	529633	717819	783150	650434	642516	644969	1066318	892037	884165	833811	
SPS NO	391345	538136	559099	485371	499977	443791	802900	694390	679659	597371	
TOT.BIOM	113469	145734	161828	141324	139189	141311	209351	177512	191370	182718	
SPS BIOM	84895	109717	115074	105577	108526	97705	158706	138410	147404	130960	

Table 6.6.1

List of input variables for the ICES prediction program.

HERRING IN DIVISIONS VIA (SOUTH) AND VIIB,C

The reference F is the mean F for the age group range from 2 to 7

The number of recruits per year is as follows:

Year	Recruitment
1988	235000.0
1989	235000.0
1990	235000.0

Proportion of F (fishing mortality) effective before spawning: .6700
 Proportion of M (natural mortality) effective before spawning: .6700

Data are printed in the following units:

Number of fish: thousands
 Weight by age group in the catch: kilogram
 Weight by age group in the stock: kilogram
 Stock biomass: tonnes
 Catch weight: tonnes

age	stock size	fishing pattern	natural mortality	maturity ogive	weight in the catch	weight in the stock
2	235000.0	1.00	.30	1.00	.115	.164
3	144907.0	1.00	.20	1.00	.151	.206
4	112714.0	1.00	.10	1.00	.171	.233
5	56321.0	1.00	.10	1.00	.177	.252
6	128262.0	1.00	.10	1.00	.194	.271
7	19991.0	1.00	.10	1.00	.202	.280
8	18145.0	1.00	.10	1.00	.214	.296
9+	26625.0	1.00	.10	1.00	.210	.317

Table 6.6.2

Effects of different levels of fishing mortality on catch, stock biomass and spawning stock biomass.

HERRING IN DIVISIONS VIA (SOUTH) AND VIIB,C

Year 1988						Year 1989						Year 1990	
fac- tor	ref. F	stock biomass	sp.stock biomass	catch	mgmt. opt.	ref. F	stock biomass	sp.stock biomass	catch	stock biomass	sp.stock biomass		
.1	.14	163	133	14	F _{0.1}	.17	172	138	18	176	141		
					F _{med}	.20		135	21	172	135		
					F ₈₇	.38		120	36	150	104		
.4	.39	163	112	35	F _{0.1}	.17	142	114	15	152	121		
					F _{med}	.20		111	17	149	116		
					F ₈₇	.38		99	30	131	90		

The data unit of the biomass and the catch is 1000 tonnes.

The spawning stock biomass is given for the time of spawning.

The spawning stock biomass for 1990 has been calculated with the same fishing mortality as for 1989.

The reference F is the mean F for the age group range from 2 to 7.

Table 6.6.3 HERRING IN DIVISIONS VIA (SOUTH) AND VIIB,C

* Year 1988. F-factor .391 and reference F .3912 *

* Run depending on a TAC value

						at 1 January		at spawning time	
age	absolute F	catch in numbers	catch in weight	stock size	stock biomass	sp. stock size	sp. stock biomass	sp. stock size	sp. stock biomass
2	.3912	66368	7632.4	235000	38540	235000	38540	147894	24254
3	.3912	42795	6462.1	144907	29850	144907	29850	97514	20088
4	.3912	34837	5957.2	112714	26262	112714	26262	81106	18897
5	.3912	17407	3081.2	56321	14192	56321	14192	40527	10212
6	.3912	39643	7690.8	128262	34759	128262	34759	92294	25011
7	.3912	6178	1248.1	19991	5597	19991	5597	14385	4027
8	.3912	5608	1200.2	18145	5370	18145	5370	13056	3864
9+	.3912	8229	1728.1	26625	8440	26625	8440	19158	6073
Total		221068	35000.0	741965	163013	741965	163013	505939	112431

* Year 1989. F-factor .200 and reference F .2000 *

						at 1 January		at spawning time	
age	absolute F	catch in numbers	catch in weight	stock size	stock biomass	sp. stock size	sp. stock biomass	sp. stock size	sp. stock biomass
2	.2000	36986	4253.4	235000	38540	235000	38540	168104	27569
3	.2000	19406	2930.4	117732	24252	117732	24252	90054	18551
4	.2000	13863	2370.6	80231	18693	80231	18693	65622	15290
5	.2000	11917	2109.4	68970	17380	68970	17380	56411	14215
6	.2000	5954	1155.2	34463	9339	34463	9339	28187	7638
7	.2000	13561	2739.4	78484	21975	78484	21975	64193	17974
8	.2000	2113	452.3	12232	3620	12232	3620	10005	2961
9+	.2000	4733	994.0	27395	8684	27395	8684	22406	7102
Total		108536	17004.7	654509	142487	654509	142487	504986	111303

* Year 1990. F-factor .200 and reference F .2000 *

						at 1 January		at spawning time	
age	absolute F	catch in numbers	catch in weight	stock size	stock biomass	sp. stock size	sp. stock biomass	sp. stock size	sp. stock biomass
2	.2000	36986	4253.4	235000	38540	235000	38540	168104	27569
3	.2000	23495	3547.8	142534	29362	142534	29362	109025	22459
4	.2000	13636	2331.8	78918	18387	78918	18387	64548	15039
5	.2000	10270	1817.8	59437	14978	59437	14978	48614	12250
6	.2000	8828	1712.7	51094	13846	51094	13846	41790	11325
7	.2000	4411	891.1	25531	7148	25531	7148	20882	5846
8	.2000	10046	2149.9	58142	17210	58142	17210	47555	14076
9+	.2000	5072	1065.2	29356	9306	29356	9306	24011	7611
Total		112746	17769.8	680015	148779	680015	148779	524533	116179

Table 7.1.1 HERRING.
Total catches (t) in North Irish Sea
(Division VIIa), 1978-1987.

Country	1978	1979	1980	1981	1982
France	174	455	1	-	-
Ireland	2,371	1,805	1,340	283	300
Netherlands	98	-	-	-	-
UK	8,432	10,078	9,272	4,094	3,375
Unallocated	-	-	-	-	1,180
Total	11,075	12,338	10,613	4,377	4,855

Country	1983	1984	1985	1986	1987
France	48	-	-	-	-
Ireland	860	1,084	1,000	1,640	1,200
Netherlands	-	-	-	-	-
UK	3,025	2,982	4,077	4,376	3,290
Unallocated	-	-	4,110	1,424	1,333
Total	3,933	4,066	9,187	7,440	5,823

Table 7.1.2 VIRTUAL POPULATION ANALYSIS

HERRING IN THE NORTHERN IRISH SEA (MANX PLUS MOURNE HERRING)

CATCH IN NUMBERS	UNIT: thousands											
-----	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983
1	40640	42150	43250	33330	34740	30280	15540	11770	5840	5050	5100	1305
2	46660	32740	109550	48240	56160	39040	36950	38270	25760	15790	16030	12162
3	26950	38240	39750	39410	20780	22690	13410	23490	19510	3200	5670	5598
4	13180	11490	24510	10840	15220	6750	6780	4250	8520	2790	2150	2820
5	13750	6920	10650	7870	4580	4520	1740	2200	1980	2300	330	445
6	6760	5070	4990	4210	2810	1460	1340	1050	910	330	1110	484
7	2660	2590	5150	2090	2420	910	670	400	360	290	140	255
8+	1670	2600	1630	1640	1270	1120	350	290	230	240	380	59
TOTAL	152270	141800	239480	147630	137980	106770	76780	81720	63110	29990	30910	23128
	1984	1985	1986	1987								
1	1168	2429	4491	2225								
2	8424	10050	15266	12981								
3	7237	17336	7462	6146								
4	3841	13287	8550	2998								
5	2221	7206	4528	4180								
6	380	2651	3198	2777								
7	229	667	1464	2328								
8+	479	724	877	1671								
TOTAL	23979	54350	45836	35306								

Table 7.3.2 HERRING IN THE NORTHERN IRISH SEA (MANX PLUS MOURNE HERRING)
 At 15.17.25 21 APRIL 1988
 from 80 to 87 on ages 1 to 7
 with Terminal F of .300 on age 2 and Terminal S of 1.000

Initial sum of squared residuals was 64.134 and
 final sum of squared residuals is 5.942 after 45 iterations

Matrix of Residuals

Years	80/81	81/82	82/83	83/84	84/85	85/86	86/87		WTS
Ages									
1/ 2	-.252	.028	.194	-.263	.325	-.281	.248	.000	.871
2/ 3	.370	.027	.017	.091	-.278	-.297	.069	-.001	1.000
3/ 4	.310	-.495	-.221	.069	-.056	.214	.178	-.001	.817
4/ 5	-.625	.955	.360	-.360	-.340	.310	-.303	-.001	.412
5/ 6	.371	-.015	-1.178	-.041	.498	.467	-.103	-.001	.397
6/ 7	-.480	-.054	.518	.401	-.034	.086	-.438	-.001	.606
	.003	.003	-.001	-.003	-.003	-.002	-.001	-.005	
WTS	1.000	1.000	1.000	1.000	1.000	1.000	1.000		
Fishing Mortalities (F)									
	80	81	82	83	84	85	86	87	
F-values	.9700	.4579	.3060	.1690	.1582	.3950	.3982	.3000	
Selection-at-age (S)									
	1	2	3	4	5	6	7		
S-values	.0872	1.0000	1.0619	1.1655	.8976	1.0160	1.0000		

Table 7.3.4 VIRTUAL POPULATION ANALYSIS

HERRING IN THE NORTHERN IRISH SEA (MANX PLUS MOURNE HERRING)

STOCK SIZE IN NUMBERS UNIT: thousands

BIOMASS TOTALS UNIT: tonnes

ALL VALUES, EXCEPT THOSE REFERRING TO THE SPAWNING STOCK ARE GIVEN FOR 1 JANUARY; THE SPAWNING STOCK DATA REFLECT THE STOCK SITUATION AT SPAWNING TIME, WHEREBY THE FOLLOWING VALUES ARE USED: PROPORTION OF ANNUAL F BEFORE SPAWNING: .900
 PROPORTION OF ANNUAL M BEFORE SPAWNING: .750

	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983
1	414195	667522	349073	368643	262760	322994	246708	136982	151329	211410	222608	222019
2	176357	129041	221246	103681	116459	76821	101427	81791	43623	52290	74844	78934
3	72523	90995	67761	71847	36201	39047	24130	43874	28383	10808	25339	41796
4	33404	35241	40305	20158	23747	11164	11803	7825	15003	5993	5977	15648
5	31474	17748	21000	13355	8002	7145	3736	4281	3067	5533	2785	3372
6	15138	15470	9508	8938	4659	2918	2205	1735	1795	909	2830	2206
7	6755	7303	9194	3889	4107	1565	1261	731	580	764	510	1510
8+	4241	7331	2910	3052	2155	1927	659	530	370	632	1385	349
TOTAL NO	754086	970653	720996	593563	458090	463582	391927	277749	244149	288340	336278	365834
SPS NO	189302	183775	140250	96981	75433	57922	68333	56419	32107	45969	73295	102244
TOT. BIOM	93466	106783	92604	68968	54440	49198	43196	34848	28195	29054	36197	42064
SPS BIOM	33804	32609	24489	16892	12772	9427	10893	9561	5424	7338	12096	17710

	1984	1985	1986	1987	1988
1	117549	146912	163493	148138	0
2	80917	42565	52635	57541	53205
3	48098	52744	22983	26033	31579
4	29176	32861	27639	12125	15790
5	11482	22752	17158	16905	8128
6	2628	8282	13758	11231	11332
7	1537	2017	4982	9415	7528
8+	3215	2190	2984	6758	10841
TOTAL NO	294603	310323	305631	288147	
SPS NO	126753	98792	89245	92366	
TOT. BIOM	40056	39835	36467	31598	
SPS BIOM	22328	16135	15697	14976	

Table 7.5.1

List of input variables for the ICES prediction program.

HERRING - NORTHERN IRISH SEA

The reference F is the mean F for the age group range from 2 to 7

The number of recruits per year is as follows:

Year	Recruitment
1988	144000.0
1989	144000.0
1990	144000.0

Proportion of F (fishing mortality) effective before spawning: .9000

Proportion of M (natural mortality) effective before spawning: .7500

Data are printed in the following units:

Number of fish:	thousands
Weight by age group in the catch:	kilogram
Weight by age group in the stock:	kilogram
Stock biomass:	tonnes
Catch weight:	tonnes

age	stock size	fishing pattern	natural mortality	maturity ogive	weight in the catch	weight in the stock
1	144000.0	.08	1.00	.08	.058	.058
2	53205.0	1.00	.30	.85	.130	.130
3	31579.0	1.00	.20	1.00	.160	.160
4	15790.0	1.00	.10	1.00	.175	.175
5	8128.0	1.00	.10	1.00	.194	.194
6	11332.0	1.00	.10	1.00	.210	.210
7	7528.0	1.00	.10	1.00	.218	.218
8+	10841.0	1.00	.10	1.00	.229	.229

Table 7.5.2 HERRING - NORTHERN IRISH SEA

 * Year 1988. F-factor .300 and reference F .3000 *

age	absolute F	catch in numbers	catch in weight	stock size	stock biomass	at 1 January		at spawning time	
						sp. stock size	sp. stock biomass	sp. stock size	sp. stock biomass
1	.0240	2162.9	125.45	144000	8352.0	11520	668.2	5325.4	308.9
2	.3000	12002.7	1560.36	53205	6916.6	45224	5879.2	27567.4	3583.8
3	.3000	7455.2	1192.84	31579	5052.6	31579	5052.6	20748.9	3319.8
4	.3000	3904.2	683.24	15790	2763.3	15790	2763.3	11182.8	1957.0
5	.3000	2009.7	389.89	8128	1576.8	8128	1576.8	5756.4	1116.7
6	.3000	2802.0	588.41	11332	2379.7	11332	2379.7	8025.6	1685.4
7	.3000	1861.4	405.78	7528	1641.1	7528	1641.1	5331.5	1162.3
8+	.3000	2680.5	613.84	10841	2482.6	10841	2482.6	7677.8	1758.2
Total		34878.6	5559.80	282403	31164.8	141942	22443.4	91615.7	14892.0

 * Year 1989. F-factor .300 and reference F .3000 *

age	absolute F	catch in numbers	catch in weight	stock size	stock biomass	at 1 January		at spawning time	
						sp. stock size	sp. stock biomass	sp. stock size	sp. stock biomass
1	.0240	2162.9	125.45	144000	8352.0	11520	668.2	5325.4	308.9
2	.3000	11667.4	1516.76	51718	6723.4	43960	5714.9	26797.1	3483.6
3	.3000	6893.5	1102.96	29199	4671.9	29199	4671.9	19185.5	3069.7
4	.3000	4735.9	828.79	19153	3351.9	19153	3351.9	13565.0	2373.9
5	.3000	2617.1	507.71	10584	2053.4	10584	2053.4	7496.1	1454.2
6	.3000	1347.2	282.90	5448	1144.2	5448	1144.2	3858.6	810.3
7	.3000	1878.2	409.45	7596	1655.9	7596	1655.9	5379.7	1172.8
8+	.3000	3044.5	697.20	12313	2819.7	12313	2819.7	8720.4	1997.0
Total		34346.6	5471.21	280013	30772.4	139775	22080.0	90327.7	14670.3

 * Year 1990. F-factor .300 and reference F .3000 *

age	absolute F	catch in numbers	catch in weight	stock size	stock biomass	at 1 January		at spawning time	
						sp. stock size	sp. stock biomass	sp. stock size	sp. stock biomass
1	.0240	2162.9	125.45	144000	8352.0	11520	668.2	5325.4	308.9
2	.3000	11667.4	1516.76	51718	6723.4	43960	5714.9	26797.1	3483.6
3	.3000	6700.9	1072.14	28383	4541.4	28383	4541.4	18649.4	2983.9
4	.3000	4379.1	766.34	17710	3099.3	17710	3099.3	12542.9	2195.0
5	.3000	3174.6	615.87	12839	2490.8	12839	2490.8	9092.9	1764.0
6	.3000	1754.3	368.40	7094	1489.9	7094	1489.9	5024.8	1055.2
7	.3000	903.0	196.86	3652	796.2	3652	796.2	2586.5	563.9
8+	.3000	3299.8	755.66	13345	3056.1	13345	3056.1	9451.6	2164.4
Total		34041.9	5417.47	278744	30549.1	138506	21856.7	89470.5	14518.9

Table 8.1.1 Catch in numbers, millions and catch in weights, tonnes.
Icelandic summer-spawning herring.

Age	1969	1970	1971	1972	1973	1974	1975
1	4.520	2.003	8.774	0.147	0.001	0.001	1.518
2	78.410	22.344	13.071	0.322	0.159	3.760	2.049
3	8.274	33.965	5.439	0.131	0.678	0.832	31.975
4	5.178	4.500	13.688	0.163	0.104	0.993	6.493
5	10.015	2.734	3.040	0.264	0.017	0.092	7.905
6	2.841	4.419	1.563	0.047	0.013	0.046	0.863
7	1.389	1.145	3.276	0.028	0.006	0.002	0.442
8	1.179	0.531	0.748	0.024	0.006	0.001	0.345
9	0.609	0.604	0.250	0.013	0.003	0.001	0.114
10	0.424	0.195	0.103	0.009	0.003	0.001	0.004
11	0.286	0.103	0.120	0.003	0.001	0.001	0.001
12	0.139	0.076	0.001	0.001	0.001	0.001	0.001
13	0.109	0.061	0.001	0.003	0.001	0.001	0.001
14	0.074	0.051	0.001	0.001	0.001	0.001	0.001
Juvenile	78.943	23.167	16.899	0.376	0.065	3.285	3.973
Adult	34.504	49.564	33.176	0.780	0.929	2.448	47.739
Total catch	20.913	15.779	10.975	0.310	0.255	1.274	13.280

Age	1976	1977	1978	1979	1980	1981	1982
1	0.614	0.705	2.634	0.929	3.147	2.283	0.454
2	9.848	18.853	22.551	15.098	14.347	4.629	19.187
3	3.908	24.152	50.995	47.561	20.761	16.771	28.109
4	34.144	10.404	13.846	69.735	60.728	12.126	38.280
5	7.009	46.357	8.738	16.451	65.329	36.871	16.623
6	5.481	6.735	39.492	8.003	11.541	41.917	38.308
7	1.045	5.421	7.253	26.040	9.285	7.299	43.770
8	0.438	1.395	6.354	3.050	19.442	4.863	6.813
9	0.296	0.524	1.616	1.869	1.796	13.416	6.633
10	0.134	0.362	0.926	0.494	1.464	1.032	10.457
11	0.092	0.027	0.400	0.439	0.698	0.884	2.354
12	0.001	0.128	0.017	0.032	0.001	0.760	0.594
13	0.001	0.001	0.025	0.054	0.110	0.101	0.075
14	0.001	0.001	0.051	0.006	0.079	0.062	0.211
Juvenile	9.573	22.321	35.502	33.011	18.438	12.764	22.889
Adult	53.439	92.744	119.396	156.750	190.290	130.250	188.979
Total catch	17.168	28.924	37.333	45.072	53.269	39.544	56.528

Age	1983	1984	1985	1986	1987
1	1.470	0.421	0.111	0.100	0.028
2	22.422	18.011	12.800	8.161	3.007
3	151.198	32.237	24.521	33.893	42.649
4	30.181	141.324	21.535	23.421	57.661
5	21.525	17.039	84.733	20.654	19.724
6	8.637	7.111	11.836	77.526	18.891
7	14.017	3.915	5.708	18.228	44.227
8	13.666	4.112	2.323	10.971	14.569
9	3.715	4.516	4.339	8.583	13.355
10	2.373	1.828	4.030	9.662	9.736
11	3.424	0.202	2.758	7.174	12.641
12	0.552	0.255	0.970	3.677	5.953
13	0.100	0.260	0.477	2.914	4.517
14	0.003	0.003	0.578	1.786	2.181
Juvenile	78.323	24.055	15.363	11.744	8.549
Adult	194.960	207.179	161.356	215.006	240.590
Total catch	58.665	50.293	49.092	65.413	73.000

Table 8.1.2 Weight at age, in grammes, Icelandic summer-spawners.

Age	1969	1970	1971	1972	1973	1974	1975
1	82.0	85.0	88.0	96.0	90.0	80.0	110.0
2	157.0	169.0	165.0	177.0	199.0	189.0	179.0
3	195.0	216.0	237.0	278.0	257.0	262.0	241.0
4	264.0	263.0	273.0	332.0	278.0	297.0	291.0
5	284.0	312.0	301.0	358.0	337.0	340.0	319.0
6	304.0	329.0	324.0	379.0	381.0	332.0	339.0
7	339.0	338.0	346.0	410.0	380.0	379.0	365.0
8	372.0	357.0	368.0	419.0	397.0	356.0	364.0
9	379.0	378.0	390.0	470.0	385.0	407.0	407.0
10	390.0	396.0	409.0	500.0	450.0	410.0	389.0
11	376.0	408.0	412.0	500.0	450.0	410.0	430.0
12	401.0	425.0	420.0	500.0	450.0	423.0	416.0
13	409.0	430.0	442.0	500.0	450.0	423.0	416.0
14	414.0	450.0	450.0	500.0	450.0	423.0	416.0

Age	1976	1977	1978	1979	1980	1981	1982
1	103.0	84.0	73.0	75.3	68.9	60.8	65.0
2	189.0	157.0	128.0	145.3	115.3	140.9	141.0
3	243.0	217.0	196.0	182.4	202.0	190.5	186.1
4	281.0	261.0	247.0	230.9	232.5	245.5	217.3
5	305.0	285.0	295.0	284.7	268.9	268.6	273.7
6	335.0	313.0	314.0	315.7	316.7	297.6	293.3
7	351.0	326.0	339.0	333.7	351.6	329.8	323.0
8	355.0	347.0	359.0	350.4	360.4	355.7	353.8
9	395.0	364.0	360.0	366.7	379.9	368.3	384.6
10	363.0	362.0	376.0	368.3	382.9	405.4	388.7
11	396.0	358.0	380.0	370.6	392.7	381.5	400.4
12	396.0	355.0	425.0	350.0	390.0	400.0	393.5
13	396.0	400.0	425.0	350.0	390.0	400.0	390.3
14	396.0	420.0	425.0	450.0	390.0	400.0	419.5

Age	1983	1984	1985	1986	1987	1988
1	59.3	49.3	53.2	60.0	60.0	60.0
2	131.7	131.4	146.0	139.7	167.5	167.5
3	179.7	188.6	219.0	200.4	200.3	200.3
4	218.1	216.8	265.8	251.6	239.8	239.8
5	259.9	244.9	285.3	282.2	277.7	277.7
6	308.6	276.9	314.6	297.9	303.7	303.7
7	328.7	314.6	334.6	320.1	325.3	325.3
8	356.5	321.7	365.0	334.4	338.8	338.8
9	370.2	350.7	388.2	372.7	355.8	355.8
10	406.9	333.8	400.5	379.6	377.6	377.6
11	436.6	361.9	453.0	393.9	400.2	400.2
12	458.6	446.3	468.9	407.8	403.6	403.6
13	429.9	417.4	432.8	404.8	424.1	424.1
14	471.5	392.3	446.7	438.9	429.6	429.6

Table 8.1.3 Proportion of mature herring in each group. Based on samples taken in Sept-Dec by purse seine.

Age	1969	1970	1971	1972	1973	1974	1975
1	0.00	0.00	0.01	0.00	0.00	0.00	0.00
2	0.08	0.22	0.38	0.29	0.64	0.14	0.27
3	0.73	0.89	0.98	1.00	0.99	0.94	0.97
4	0.99	1.00	1.00	1.00	1.00	1.00	1.00
5	1.00	1.00	1.00	1.00	1.00	1.00	1.00
6	1.00	1.00	1.00	1.00	1.00	1.00	1.00
7	1.00	1.00	1.00	1.00	1.00	1.00	1.00
8	1.00	1.00	1.00	1.00	1.00	1.00	1.00
9	1.00	1.00	1.00	1.00	1.00	1.00	1.00
10	1.00	1.00	1.00	1.00	1.00	1.00	1.00
11	1.00	1.00	1.00	1.00	1.00	1.00	1.00
12	1.00	1.00	1.00	1.00	1.00	1.00	1.00
13	1.00	1.00	1.00	1.00	1.00	1.00	1.00
14	1.00	1.00	1.00	1.00	1.00	1.00	1.00

Age	1976	1977	1978	1979	1980	1981	1982
1	0.00	0.00	0.00	0.00	0.00	0.00	0.02
2	0.13	0.02	0.04	0.07	0.05	0.03	0.05
3	0.90	0.87	0.78	0.65	0.92	0.65	0.85
4	1.00	1.00	1.00	0.98	1.00	0.99	1.00
5	1.00	1.00	1.00	1.00	1.00	1.00	1.00
6	1.00	1.00	1.00	1.00	1.00	1.00	1.00
7	1.00	1.00	1.00	1.00	1.00	1.00	1.00
8	1.00	1.00	1.00	1.00	1.00	1.00	1.00
9	1.00	1.00	1.00	1.00	1.00	1.00	1.00
10	1.00	1.00	1.00	1.00	1.00	1.00	1.00
11	1.00	1.00	1.00	1.00	1.00	1.00	1.00
12	1.00	1.00	1.00	1.00	1.00	1.00	1.00
13	1.00	1.00	1.00	1.00	1.00	1.00	1.00
14	1.00	1.00	1.00	1.00	1.00	1.00	1.00

Age	1983	1984	1985	1986	1987	1988
1	0.00	0.00	0.00	0.00	0.00	0.00
2	0.00	0.01	0.00	0.03	0.01	0.03
3	0.64	0.82	0.90	0.89	0.87	0.89
4	1.00	1.00	1.00	1.00	1.00	1.00
5	1.00	1.00	1.00	1.00	1.00	1.00
6	1.00	1.00	1.00	1.00	1.00	1.00
7	1.00	1.00	1.00	1.00	1.00	1.00
8	1.00	1.00	1.00	1.00	1.00	1.00
9	1.00	1.00	1.00	1.00	1.00	1.00
10	1.00	1.00	1.00	1.00	1.00	1.00
11	1.00	1.00	1.00	1.00	1.00	1.00
12	1.00	1.00	1.00	1.00	1.00	1.00
13	1.00	1.00	1.00	1.00	1.00	1.00
14	1.00	1.00	1.00	1.00	1.00	1.00

Table 8.3.1 Stock abundance and catches by age groups (millions) and fishing mortality rates for the Icelandic summer spawners. F' is the F in 1987 calculated from the November/December survey. F_p is the fishing pattern in 1987 calculated from November-December survey. F_{87} is the fishing mortality in 1987 according to the new method introduced in the 1986 Working Group report.

Rings in 1987	Acoustic survey estimate Nov-Dec 1987	Catches in 1987	F'	F_p	F_{87}
0	607.0	-	-	-	-
1	174.0	-	-	-	-
2	465.0	3.0	0.006	0.015	0.006
3	1,081.0	43.0	0.038	0.100	0.038
4	366.0	58.0	0.140	0.360	0.130
5	67.0	20.0	0.250	0.650	0.234
6	46.0	19.0	0.330	1.000	0.360
7	95.0	44.0	0.360	1.000	0.360
8	31.0	15.0	0.380	1.000	0.360
9	26.0	13.0	0.390	1.000	0.360
10	18.0	10.0	0.420	1.000	0.360
11	21.0	13.0	0.460	1.000	0.360
12	10.0	6.0	0.450	1.000	0.360
13	7.7	4.5	0.440	1.000	0.360
14	4.4	2.1	0.370	1.000	0.360

Table 8.3.2 Icelandic summer-spawners. Fishing mortalities.

Age	1969	1970	1971	1972	1973	1974	1975
1	0.104	0.064	0.140	0.002	0.000	0.000	0.007
2	0.847	0.908	0.647	0.006	0.002	0.010	0.017
3	0.579	1.012	0.510	0.010	0.014	0.013	0.102
4	0.657	0.637	1.502	0.022	0.009	0.024	0.117
5	0.722	0.779	1.088	0.078	0.003	0.009	0.238
6	0.829	0.726	1.354	0.035	0.004	0.008	0.097
7	0.920	0.855	2.009	0.059	0.005	0.001	0.087
8	0.899	1.014	3.213	0.055	0.015	0.001	0.156
9	0.857	1.717	2.353	0.628	0.008	0.003	0.123
10	0.943	0.655	1.963	0.485	0.253	0.003	0.012
11	1.219	0.548	0.989	0.223	0.080	0.112	0.003
12	1.110	1.204	0.008	0.016	0.097	0.097	0.141
13	0.799	3.564	0.035	0.027	0.018	0.119	0.119
14	0.700	1.000	1.000	0.040	0.010	0.020	0.150

Average weighted by stock in numbers

ave 4-14 0.751 0.756 1.535 0.043 0.007 0.018 0.153

Age	1976	1977	1978	1979	1980	1981	1982
1	0.001	0.002	0.013	0.004	0.012	0.002	0.002
2	0.053	0.039	0.055	0.084	0.062	0.020	0.023
3	0.037	0.160	0.125	0.142	0.143	0.087	0.148
4	0.136	0.117	0.116	0.226	0.242	0.104	0.259
5	0.160	0.246	0.123	0.177	0.303	0.203	0.182
6	0.230	0.204	0.304	0.141	0.162	0.290	0.299
7	0.147	0.332	0.313	0.299	0.217	0.132	0.489
8	0.105	0.265	0.710	0.187	0.339	0.151	0.157
9	0.174	0.159	0.491	0.411	0.144	0.368	0.281
10	0.186	0.297	0.408	0.241	0.579	0.104	0.484
11	0.367	0.047	0.547	0.307	0.554	0.740	0.321
12	0.004	1.130	0.034	0.067	0.001	2.120	1.651
13	0.183	0.004	0.605	0.128	0.304	0.107	1.620
14	0.150	0.250	0.250	0.250	0.250	0.250	0.300

Average weighted by stock in numbers

ave 4-14 0.146 0.213 0.227 0.222 0.262 0.211 0.303

Age	1983	1984	1985	1986	1987	1981-1984
1	0.007	0.001	0.000	0.000	0.000	0.003
2	0.116	0.094	0.021	0.006	0.006	0.063
3	0.231	0.217	0.160	0.063	0.038	0.171
4	0.209	0.312	0.197	0.202	0.130	0.221
5	0.203	0.157	0.278	0.262	0.234	0.186
6	0.122	0.086	0.140	0.392	0.360	0.199
7	0.152	0.067	0.083	0.294	0.360	0.210
8	0.246	0.055	0.047	0.203	0.360	0.152
9	0.108	0.108	0.068	0.216	0.360	0.216
10	0.138	0.064	0.119	0.190	0.360	0.197
11	0.255	0.014	0.117	0.285	0.360	0.333
12	0.104	0.024	0.078	0.201	0.360	0.975
13	1.534	0.058	0.052	0.312	0.360	0.830
14	0.200	0.130	0.160	0.250	0.360	0.220

Average weighted by stock in numbers

ave 4-14 0.183 0.212 0.186 0.283 0.237 0.226

Table 8.3.3 Icelandic summer-spawners. VPA stock size in number (millions) and spawning stock biomass at 1 July.

Age	1969	1970	1971	1972	1973	1974	1975
1	47.909	33.806	70.348	84.793	426.779	140.809	222.517
2	143.274	39.056	28.685	55.320	76.584	386.164	127.408
3	19.684	55.602	14.252	13.593	49.750	69.145	345.841
4	11.242	9.981	18.281	7.746	12.175	44.371	61.774
5	20.344	5.275	4.775	3.682	6.854	10.918	39.204
6	5.263	8.942	2.190	1.456	3.081	6.185	9.791
7	2.409	2.079	3.914	0.512	1.273	2.775	5.553
8	2.073	0.869	0.800	0.475	0.436	1.146	2.509
9	1.104	0.763	0.285	0.029	0.407	0.389	1.036
10	0.724	0.424	0.124	0.025	0.014	0.366	0.351
11	0.422	0.255	0.199	0.016	0.014	0.010	0.330
12	0.216	0.113	0.134	0.067	0.011	0.011	0.008
13	0.207	0.064	0.031	0.120	0.060	0.009	0.009
14	0.154	0.084	0.002	0.027	0.106	0.053	0.008
Juvenile	185.149	70.386	87.714	124.070	454.847	477.059	325.900
Sp. stock							
biomass	16.737	20.009	13.572	11.041	28.705	45.642	118.358

Age	1976	1977	1978	1979	1980	1981	1982
1	576.958	487.424	220.488	276.419	271.098	963.989	238.534
2	199.899	521.469	440.369	197.001	249.231	242.308	870.083
3	113.336	171.516	453.925	377.030	163.908	211.879	214.849
4	282.553	98.836	132.260	362.291	295.982	128.594	175.781
5	49.728	223.236	79.547	106.522	261.632	210.189	104.837
6	27.972	38.340	158.004	63.678	80.766	174.774	155.188
7	8.040	20.109	28.298	105.513	50.017	62.121	118.382
8	4.605	6.282	13.055	18.727	70.774	36.445	49.277
9	1.943	3.750	4.361	5.806	14.049	45.605	28.359
10	0.829	1.477	2.896	2.416	3.483	11.007	28.547
11	0.314	0.623	0.993	1.743	1.717	1.766	8.979
12	0.298	0.197	0.538	0.520	1.161	0.893	0.762
13	0.006	0.268	0.058	0.471	0.440	1.049	0.097
14	0.008	0.005	0.242	0.028	0.375	0.294	0.853
Juvenile	762.203	1020.761	743.105	598.837	520.981	1274.471	1092.569
Sp. stock							
biomass	132.575	139.246	185.512	213.889	235.708	212.321	223.397

Age	1983	1984	1985	1986	1987	1988
1	234.956	728.999	1496.392	574.312	196.170	607.000
2	215.403	211.199	659.225	1353.886	519.564	177.475
3	769.043	173.605	173.989	584.323	1217.288	467.262
4	167.709	552.371	126.488	134.147	496.508	1060.908
5	122.734	123.102	365.779	94.008	99.149	394.492
6	79.078	90.622	95.207	250.589	65.466	70.996
7	104.086	63.349	75.242	74.906	153.268	41.328
8	65.667	80.870	53.600	62.658	50.489	96.755
9	38.118	46.450	69.266	46.291	46.281	31.873
10	19.368	30.961	37.740	58.551	33.740	29.217
11	15.928	15.271	26.278	30.320	43.807	21.299
12	5.892	11.163	13.626	21.157	20.630	27.655
13	0.132	4.807	9.858	11.407	15.654	13.023
14	0.017	0.026	4.102	8.467	7.558	9.882
Juvenile	727.214	969.335	2173.017	1951.858	868.786	830.550
Sp. stock						
biomass	257.400	273.143	298.004	340.588	486.322	539.217

Table 8.4.1 Input parameters used in catch prediction for the Icelandic summer-spawning (Division Va) herring.

Ring	Stock in number		Mean weight in catch and spawning stock (g)
	('000) at 1 January 1988	Proportional F	
1	607.000	0.005	60.0
2	177.475	0.15	135.7
3	467.262	0.50	196.9
4	1060.908	1.00	240.5
5	394.492	1.00	274.2
6	70.996	1.00	304.1
7	41.328	1.00	327.7
8	96.755	1.00	348.5
9	31.873	1.00	372.3
10	29.217	1.00	384.5
11	21.299	1.00	415.5
12	27.655	1.00	427.7
13	13.023	1.00	430.6
14	9.882	1.00	439.7

Table 8.4.2 ICELANDIC SUMMER-SPAWNING HERRING

 * Year 1988. F-factor .220 and reference F .2200 *

age	absolute F	catch in numbers	catch in weight	stock size	stock biomass	at 1 January		at spawning time	
						sp. stock size	sp. stock biomass	sp. stock size	sp. stock biomass
1	.0011	635	38	607000	36420	0	0	0	0
2	.0330	5483	744	177475	24083	1774	240	1688	229
3	.1100	46360	9128	467262	92003	406517	80043	386691	76139
4	.2200	199739	48037	1060908	255148	1060908	255148	1009166	242704
5	.2200	74272	20365	394492	108169	394492	108169	375252	102894
6	.2200	13366	4064	70996	21589	70996	21589	67533	20536
7	.2200	7780	2549	41328	13543	41328	13543	39312	12882
8	.2200	18216	6348	96755	33719	96755	33719	92036	32074
9	.2200	6000	2234	31873	11866	31873	11866	30318	11287
10	.2200	5500	2115	29217	11233	29217	11233	27792	10686
11	.2200	4010	1666	21299	8849	21299	8849	20260	8418
12	.2200	5206	2226	27655	11828	27655	11828	26306	11251
13	.2200	2451	1055	13023	5607	13023	5607	12387	5334
14	.2200	1860	818	9882	4345	9882	4345	9400	4133
Total		390886	101392	3049165	638408	2205721	566185	2098146	538572

 * Year 1989. F-factor .220 and reference F .2200 *

age	absolute F	catch in numbers	catch in weight	stock size	stock biomass	at 1 January		at spawning time	
						sp. stock size	sp. stock biomass	sp. stock size	sp. stock biomass
1	.0011	418	25.1	400000	24000	0	0	0	0
2	.0330	16952	2300.5	548632	74449	5486	744	5218	708
3	.1100	15415	3035.4	155373	30592	135174	26615	128582	25317
4	.2200	71309	17149.9	378755	91090	378755	91090	360283	86648
5	.2200	145040	39770.2	770377	211237	770377	211237	732805	200935
6	.2200	53932	16400.9	286460	87112	286460	87112	272489	82863
7	.2200	9706	3180.7	51553	16894	51553	16894	49039	16070
8	.2200	5650	1969.1	30010	10458	30010	10458	28546	9948
9	.2200	13227	4924.7	70258	26157	70258	26157	66832	24881
10	.2200	4357	1675.5	23144	8899	23144	8899	22015	8465
11	.2200	3994	1659.7	21215	8815	21215	8815	20181	8385
12	.2200	2911	1245.4	15466	6614	15466	6614	14711	6292
13	.2200	3780	1628.0	20081	8647	20081	8647	19102	8225
14	.2200	1780	782.9	9456	4158	9456	4158	8995	3955
Total		348478	95747.7	2780786	609127	1817441	507445	1728803	482697

 * Year 1990. F-factor .220 and reference F .2200 *

age	absolute F	catch in numbers	catch in weight	stock size	stock biomass	at 1 January		at spawning time	
						sp. stock size	sp. stock biomass	sp. stock size	sp. stock biomass
1	.0011	418	25.1	400000	24000	0	0	0	0
2	.0330	11711	1516.0	361537	49060	3615	490	3439	466
3	.1100	47655	9383.3	480308	94572	417868	82278	397488	78265
4	.2200	23711	5702.6	125943	30289	125943	30289	119800	28812
5	.2200	51781	14198.4	275032	75413	275032	75413	261619	71736
6	.2200	105321	32028.2	559408	170116	559408	170116	532126	161819
7	.2200	39163	12833.7	208012	68165	208012	68165	197867	64841
8	.2200	7048	2456.3	37435	13046	37435	13046	35609	12410
9	.2200	4102	1527.5	21791	8113	21791	8113	20729	7171
10	.2200	9605	3693.2	51018	19616	51018	19616	48529	18659
11	.2200	3164	1314.7	16806	6983	16806	6983	15986	6642
12	.2200	2900	1240.5	15405	6589	15405	6589	14654	6267
13	.2200	2114	910.5	11230	4835	11230	4835	10683	4600
14	.2200	2745	1207.2	14582	6411	14582	6411	13871	6099
Total		310902	88037.2	2578514	577214	1758152	492350	1672406	468337

Table 9.1 Survey of abundance indices used in ICES herring assessments in 1987 (Anon., 1987) and 1988 (this report).

Assessment		Index					
Stock	Year	CPUE	LAI	LPE	YFS	Acoustic (adult)	Acoustic (recruit)
North Sea	1987		+	+	+	+	+
North Sea	1988		+	+	+	+	+
Celtic Sea + VIIj	1987						
Celtic Sea + VIIj	1988						
West of Scotland VIa(N)	1987		+	+	+	+	+
West of Scotland VIa(N)	1988		+	+	+	+	+
Clyde	1987	+					
Clyde	1988	+				+	
VIa South + VIIb,c	1987		+	+	+		
VIa South + VIIb,c	1988	+	+	+			
Iceland	1987					+	+
Iceland	1988					+	+
Irish Sea VIIa	1987	+			+		
Irish Sea VIIa	1988	+			+		
Division IIIa	1987				+	+	+
Division IIIa	1988				+	+	+

Table 9.2 Application of abundance indices.

Index	Assessment		Application
	Stock	Year	
Acoustic abundance of recruits	Iceland	1987	Absolute abundance of 0- and 1- ringers from special coastal survey in November and December. Very low number indicates incomplete coverage of juvenile distribution.
		1988	1987 survey included juvenile aggregations along northern coast.
	VIa (North)	1987	Absolute abundance from 1-ring portion of divisional acoustic survey. Very much a minimum estimate - some indication that juveniles may arrive from the North Sea after November survey.
		1988	
	North Sea	1987	Absolute abundance for young fish available from several acoustic surveys; particularly abundant in Danish coast - August survey.
		1988	Acoustic abundance of 1-ringers was matched with VPA and IYFS and used to estimate 2-group recruitment.
IIIa	1988	A portion of 2-group estimate added to North Sea estimate of recruitment.	
Acoustic abundance of adults	Iceland	1987	Winter survey (December - January) of adults after closure of fishery used for absolute abundance by age. Series of survey results (since 1973) has been used to tune VPA. January 1987 survey affected by unusual distribution of fish.
		1988	Relationship between acoustic and VPA biomass (11-year series) used to chose terminal F (on the basis of minimum SSE).
	VIa (North)	1987	November 1986 survey used to produce absolute abundance by age. Considered an underestimate because area coverage was incomplete due to bad weather and the 1983 year class was not fully represented. Time series 1983, 1985, 1986. Independent estimate used in 1986 to support LAI tuning.
		1988	Acoustic survey results used as an absolute spawning stock biomass; since LAI demonstrated the same trend, SSB was used as direct measure of population size for VPA.

Table 9.2 (cont'd)

Index	Assessment		Application
	Stock	Year	
Acoustic abundance of adults	North Sea		Several acoustic surveys produce absolute abundance for individual areas:
			Northern North Sea - July
			IVb + IVa south - November/December
			Danish coast - August 1979
			IVb west - August/September 1981-1987
		Southern North Sea - November/December/February + VIId Channel	
	1987	July IVa and August IVb results (combined) for 1981-1986 were used with LPE to tune VPA (SSB) for IVa + IVb; using sum of residuals (1984-1986) equal to 0.	
	1988	Acoustic surveys used to tune VPA by max. correlation coefficient (VPA-derived biomass versus acoustic biomass).	
	IIIa	1987	Three acoustic surveys of the area in 1986 (August, September, November). Considered to be an underestimate of adult herring in area.
	Clyde	1988	First year of acoustic survey indicated a low biomass and was considered to have had incomplete coverage of total stock.
Larval abundance index			Calculated (as described by Saville and Rankine, 1985) as the average occurrence of small (<10mm) larvae taken in standard survey rectangles by repetitive surveys covering the spawning period. Used (prior to 1986) in regression with spawning stock biomass to tune VPA. Now calculated for comparison with LPE. Concern expressed that the method relies on sampling the small larvae within approximately the first two weeks, and is therefore vulnerable to patchy distribution, sampling time in relation to hatching and periods between sampling.
	North Sea	1987	LAI for the period 1972-present calculated for five five areas of North Sea. 1985 LAI for Orkney-Shetland considered to be a gross overestimate; 1986 for the Buchan an underestimate due to missed cohorts. Replaced by LPE in tuning.
		1988	Conflicting trends compared with LPE for the last three years. Not used in tuning.
		VIIa (South) + VIIb,c	

Table 9.2 (cont'd)

Index	Assessment		Application
	Stock	Year	
Larval abundance index	VIa (South) + VIIB,c	1987	In 1986, the area was surveyed twice in October and once in November (hatching estimated to have peaked mid-October). LAI used with LPE as evidence for a decline in stock abundance, but not used in tuning because of apparently high values in 1986.
		1988	Three surveys were undertaken in 1987, with expanded coverage. LAI is lower than in 1986, perhaps as a result of incomplete temporal coverage. No correlation with any VPA run in attempted tuning.
	VIa (North)	1987	Two surveys in September and two in August. LAI used for tuning VPA in 1987 assessment (LAI versus SSB); using sum of residuals for most recent 3 and 5 years equal to 0.
		1988	Recent points are beyond documented range of LAI regression and could not be used in tuning.
Larval production estimate			LPE (described in Herring Larvae Working Group Report, 1987). Has advantage of requiring less sampling effort, but requires mortality rates and near-even sampling over time.
	North Sea	1987	LPE for 1972-1986 period used in conjunction with acoustic estimates to tune 1987 VPA for IVa,b.
		1988	Conflicting trends compared with LPE. Acoustic estimate considered preferable for tuning VPA.
	VIa (North)	1987	LPE for 1986 showed an anomalous increase over 1985 and was not used in tuning.
		1988	LPE showed a poor relationship with SSB derived from any VPA and was not used in tuning.
	VIa (South) + VIIB,c	1987	LPE used in 1987 with LAI as evidence for a decline in stock abundance, but not used in tuning because of apparently high values obtained in 1986.
1988		No correlation with VPA; not used in tuning.	
Young fish survey	North Sea	1987	IYFS index based upon survey of standard area (abundance 1-group/hr/rectangle) available since 1970 (1968 year class). Shows a very good relationship with 1-group estimates from total North Sea VPA in 1987.

Table 9.2 (cont'd)

Index	Assessment		Application
	Stock	Year	
Young fish survey	North Sea	1987	IKMT index available since 1976 has shown early indication of relative year-class strength (e.g., the strong 1985 year class).
		1988	IYFS index shows strong recent year classes. Used in conjunction with acoustic and VPA results to estimate 2-group recruitment. IKMT index used as a qualitative indicator of strong or poor year classes.
	Irish Sea	1987	Poor relationship between Irish young fish survey (1980-1987) results and VPA recruitment; not used.
		1988	
	VIa (North)	1987	Abundance indices of 2-ring herring based on normalized tows in sub-areas off the north coast of Scotland and in the North Minch since 1981; used as indication of recruitment.
		1988	The young fish abundance index is the highest in the series and indicates a relatively strong 1985 year class.
	VIa (South) + VIIb,c	1987	0- and 1-group indices from Irish trawl surveys since 1981 have indicated relatively strong 1981, 1983, 1985, and 1986 year classes, but have shown little relationship with the results from VPA.
		1988	Results of 1987 survey indicate the highest 1-group abundance since 1981, but the series does not match the trend indicated by VPA.
	IIIa	1987	1987 IYFS hampered by ice cover, and coverage was less than usual. Resulting 1- and 2-group indices may be underestimates.
		1988	Survey indicates record high abundance of 1- and 2-group herring of North Sea origin. Used to confirm that the North Sea recruitment index (based upon standard stations) is conservative.
Catch per unit effort	Clyde	1987	Effort (days fished; 1974-present) used to tune VPA by iterative calculation of fishing mortality in index years.
		1988	Converged VPA correlated against effort index to predict F in current year.
	Irish Sea	1987	Effort (landings; 1980-present) used to tune VPA. Tuning by maximum correlation coefficient, minimum SSR (1983-1986) and coincidence of input and predicted F.

Figure 2.3.1 Regression of VPA 1-ringers on IYFS indices. Recent year classes indicated by asterisk have not been used in calculating the regression. The dotted line represents the regression line traced through this origin.

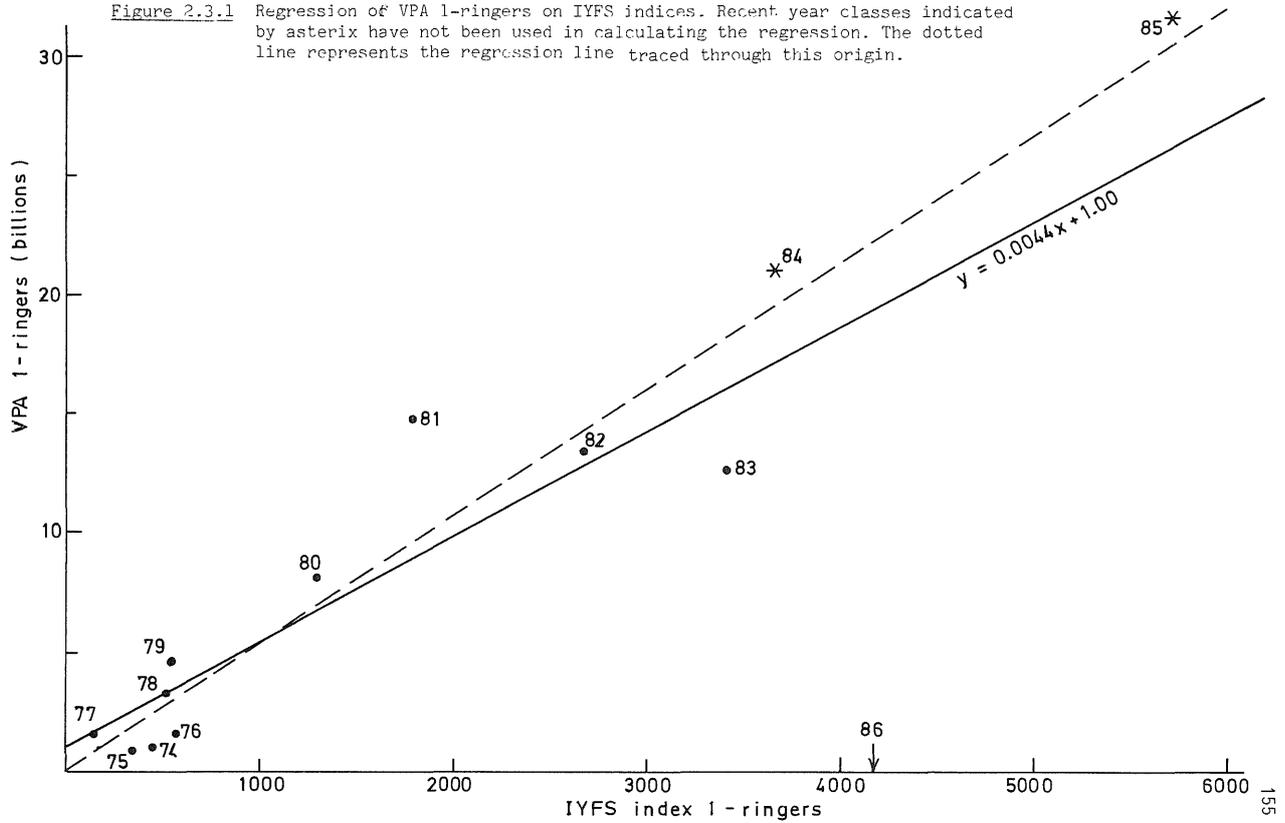


Figure 2.3.2 Area divisions used in calculating new IKM_I indices.

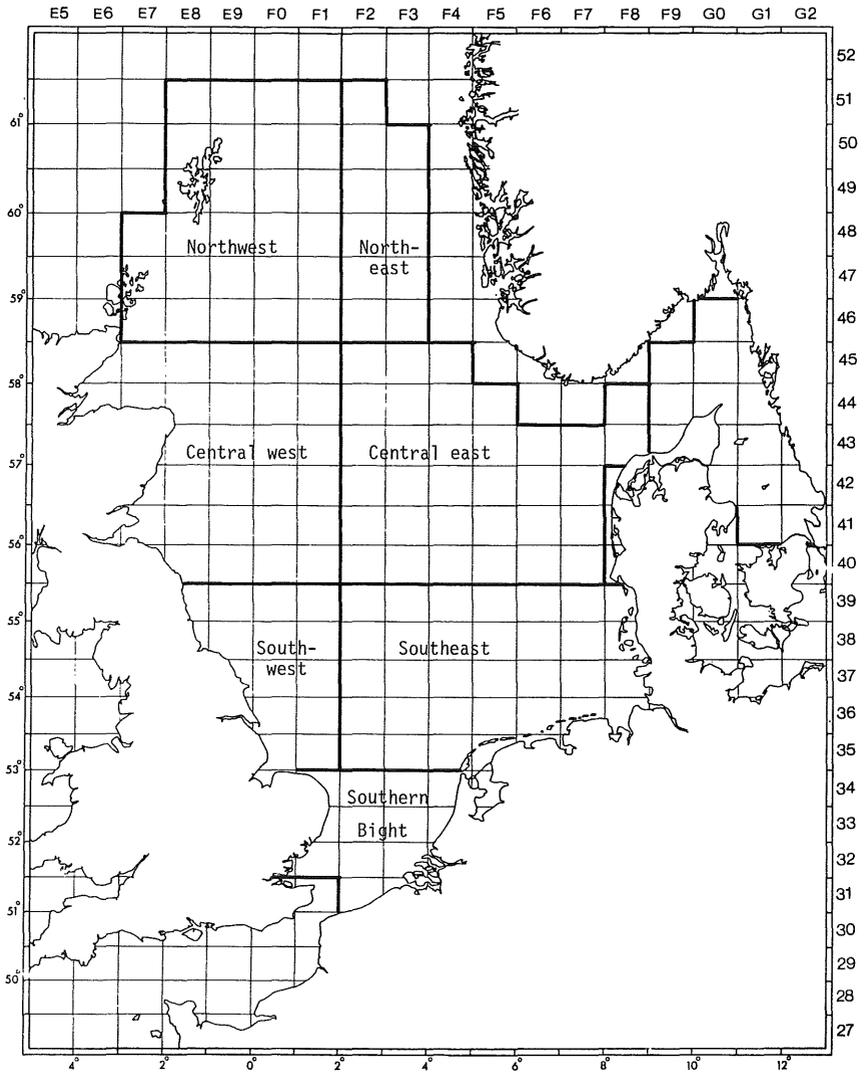
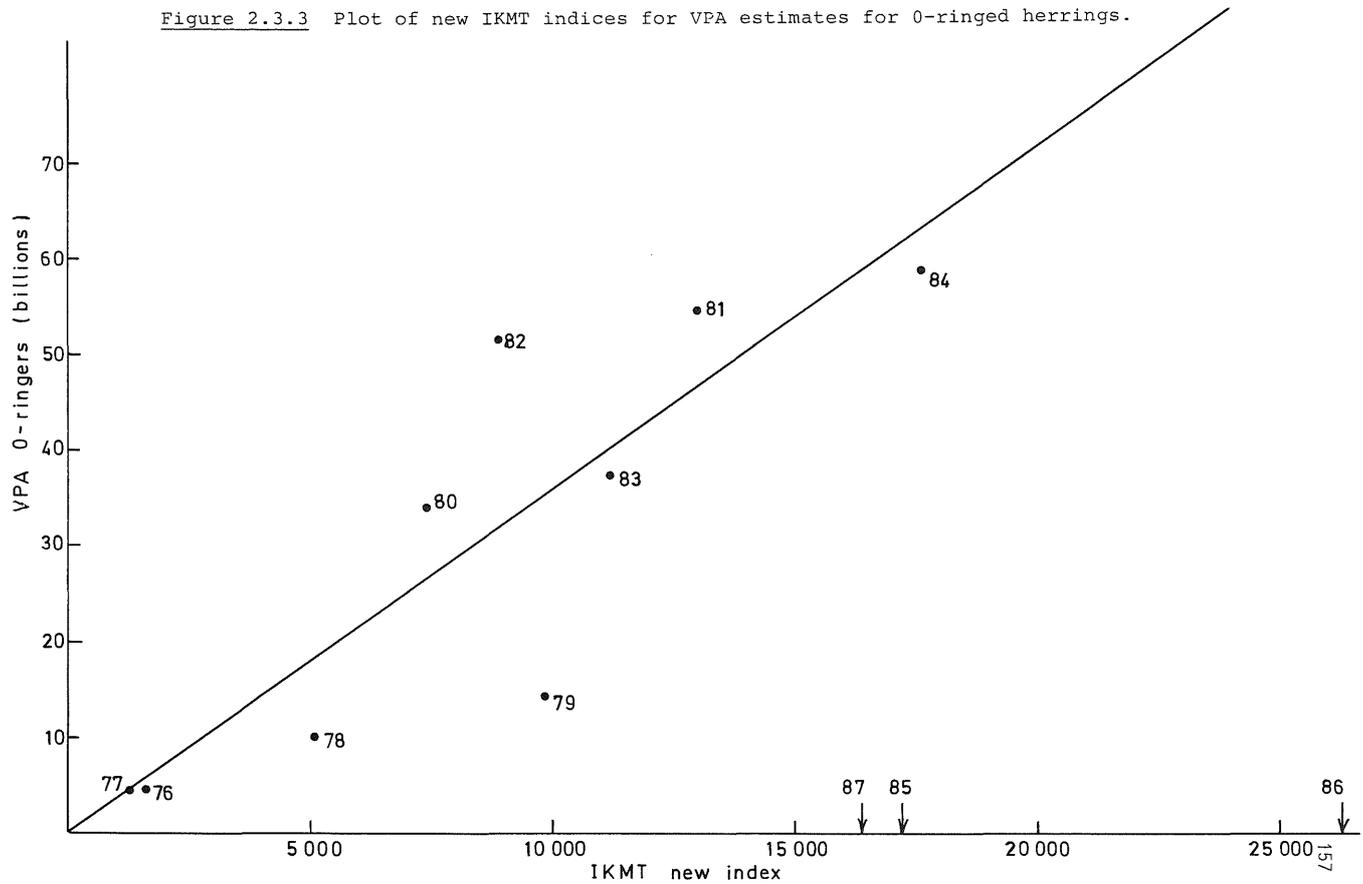


Figure 2.3.3 Plot of new IKMT indices for VPA estimates for 0-ringed herrings.



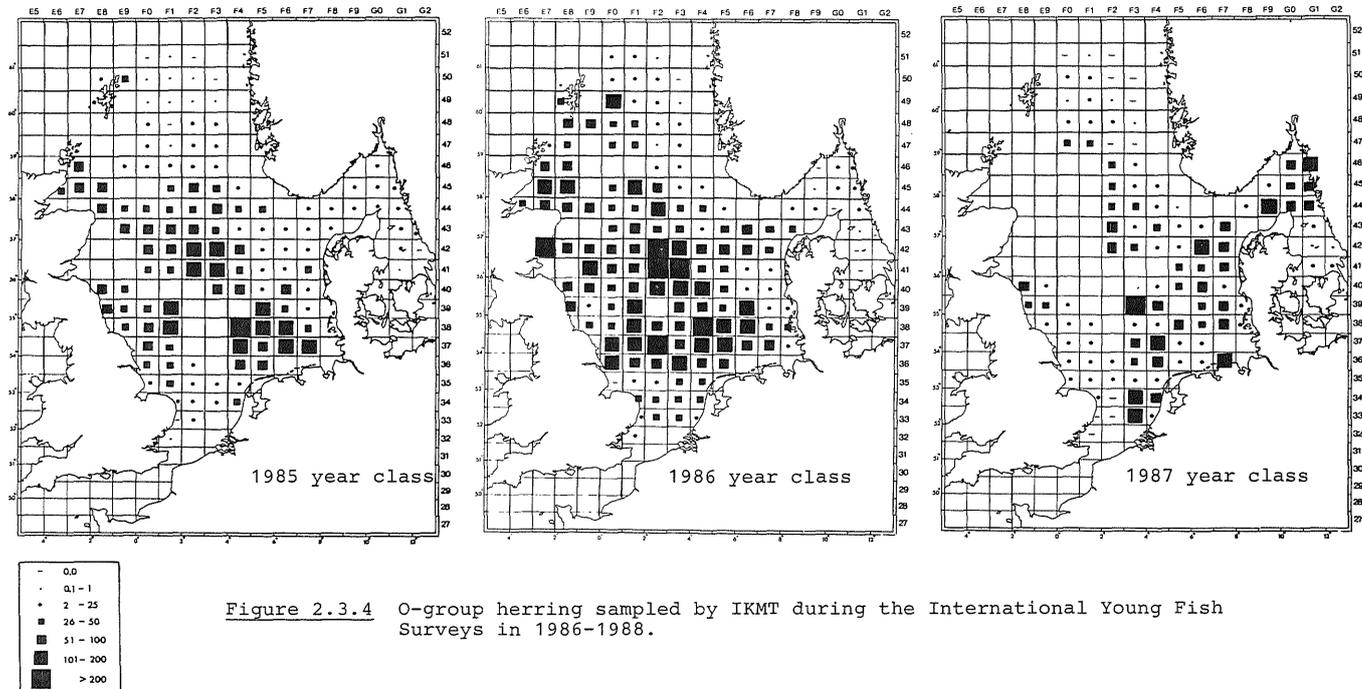


Figure 2.3.4 O-group herring sampled by IKMT during the International Young Fish Surveys in 1986-1988.

Figure 2.3.5 Herring. Total North Sea. Year-class strength as 1-ringers from the VPA for the years 1947-1985, and predicted from IYFS regression for 1986.

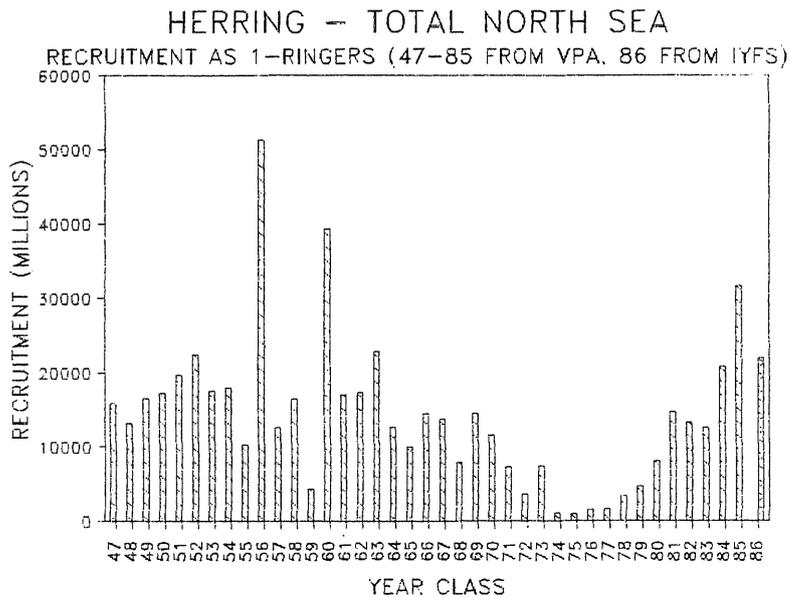


Figure 2.4.1 Estimated numbers (millions) of all age group of herring during the acoustic survey Jun-Aug 1987.

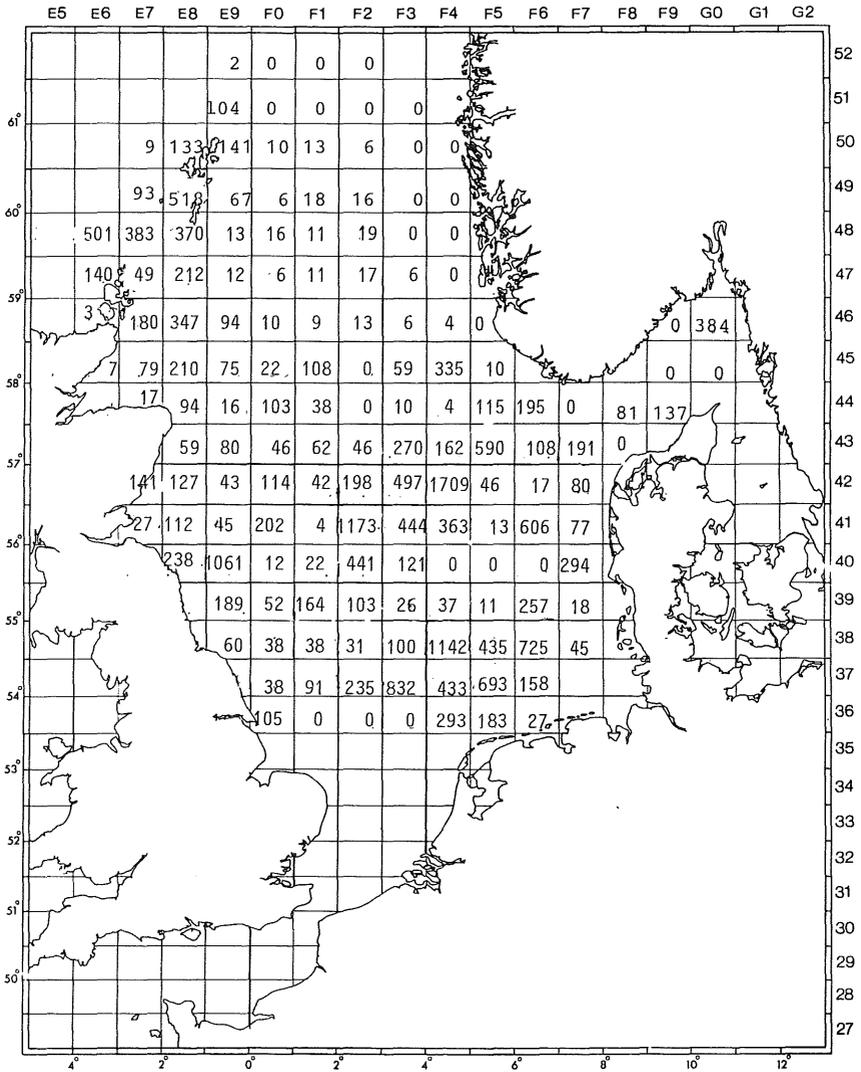


Figure 2.5.1 Estimates of SSB for the total North Sea from the VPA and predicted from LPE and LAI regressions with the VPA over the years 1972-1987.

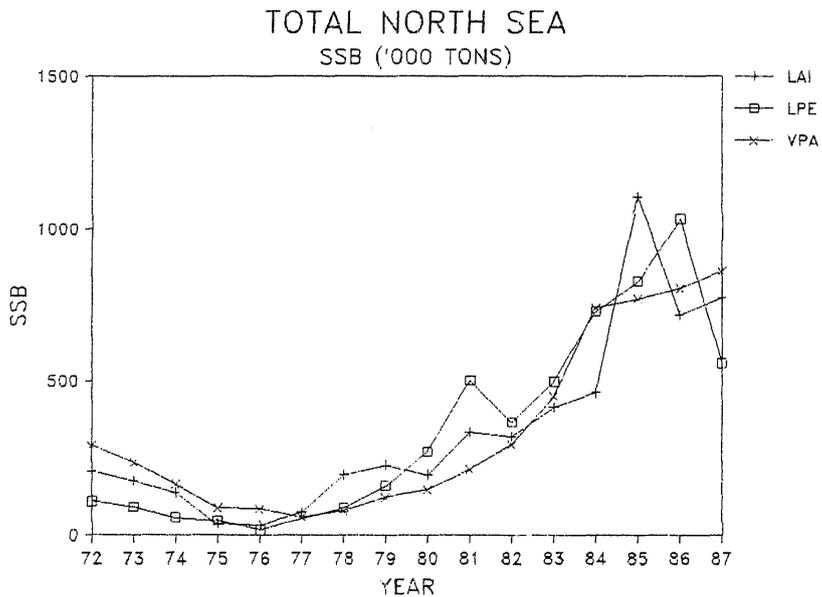


Figure 2.5.2 . SSB estimated from LPE and VPA for the total North Sea.
The regression line is $SSB = 0.859 \times LPE$ ($r = 0.88$).

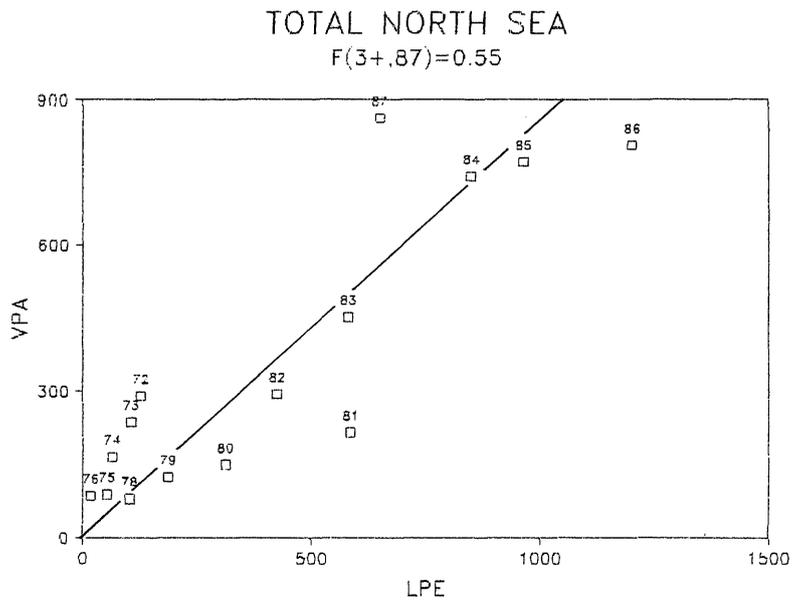


Figure 2.5.3 SSB estimated from LAI and VPA for the total North Sea.
The regression line is $SSB = 0.0324 \times LAI$ ($r = 0.90$).

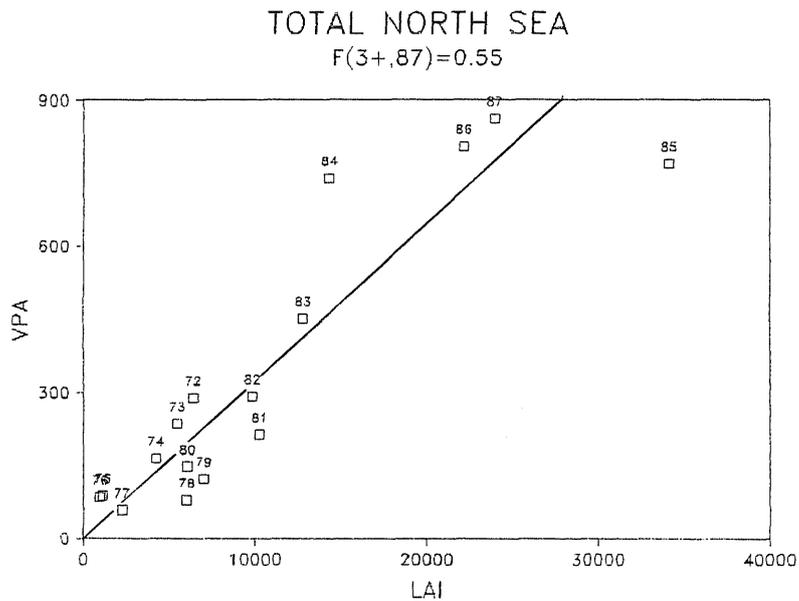


Figure 2.8.1 Acoustic estimates and VPA estimates of spawning stock biomass in total North Sea. The VPA is run with an input $F_{3+} = 0.55$. The regression line is shown compared to the 1:1 line.

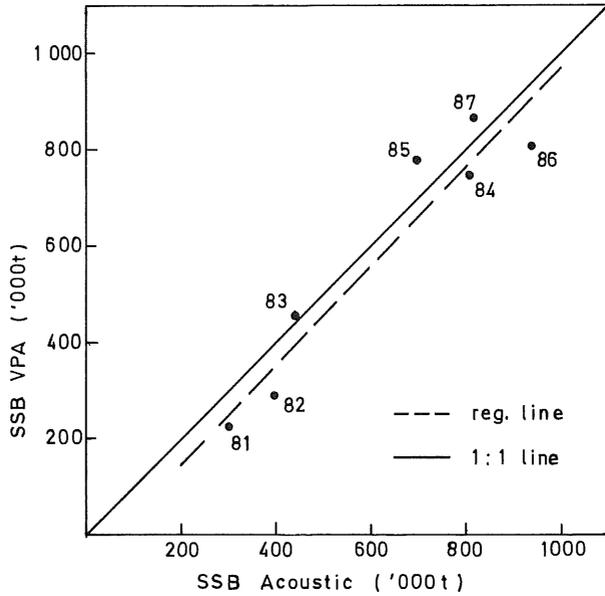
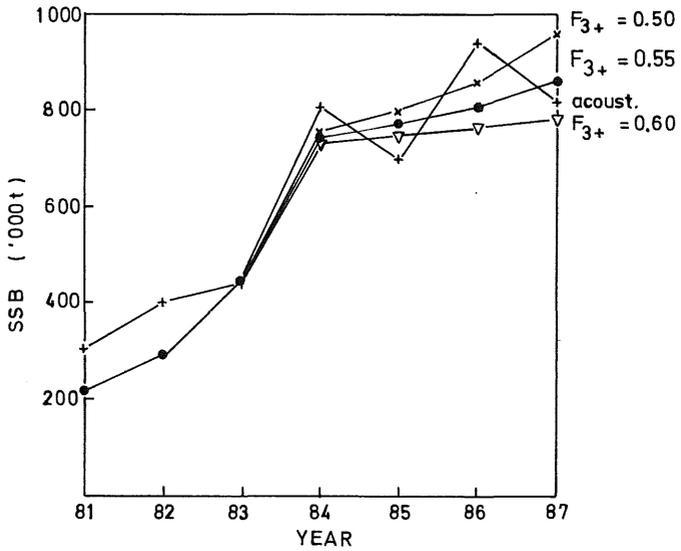


Figure 2.8.2 HERRING, Total North Sea.



HERRING - TOTAL NORTH SEA
 RECRUITMENT AS 1-RINGERS FROM VPA

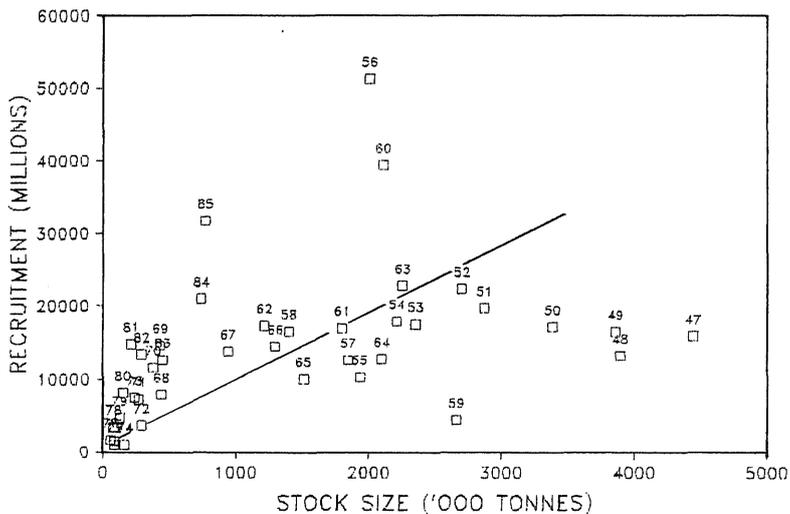


Figure 2.8.3 Herring. Total North Sea. Spawning stock size and resulting year class strength as 1-ringers from the VPA. The line corresponding to an F of 0.35 is also shown.

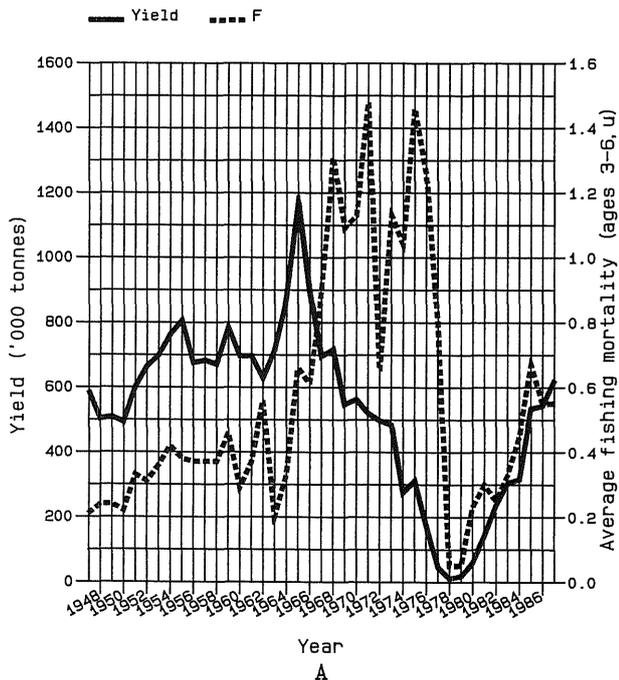
FISH STOCK SUMMARY

STOCK: Herring - Total North Sea

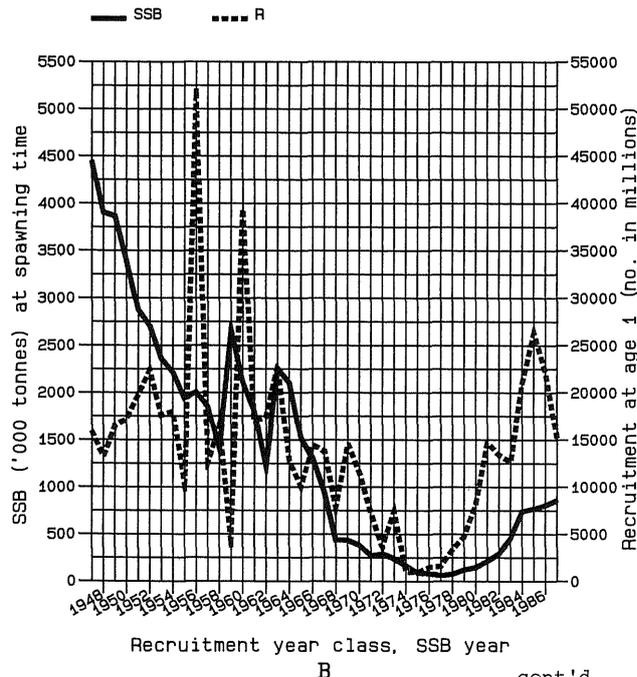
21-04-1988

Figure 2.9.1

Trends in yield and fishing mortality (F)



Trends in spawning stock biomass (SSB) and recruitment (R)



cont'd.

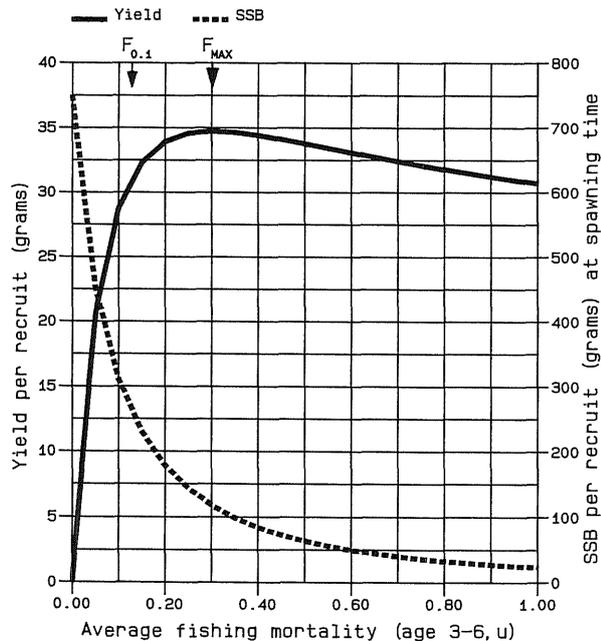
FISH STOCK SUMMARY

STOCK: Herring - Total North Sea

21-04-1988

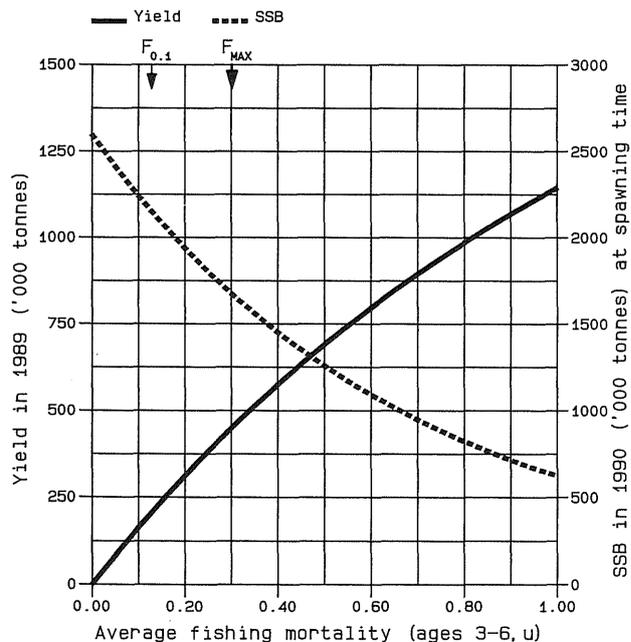
Figure 2.9.1 cont'd.

Long-term yield and spawning stock biomass



C

Short-term yield and spawning stock biomass



D

Figure 2.11.4 North Sea herring, 1987. Total catch, April 989 t.

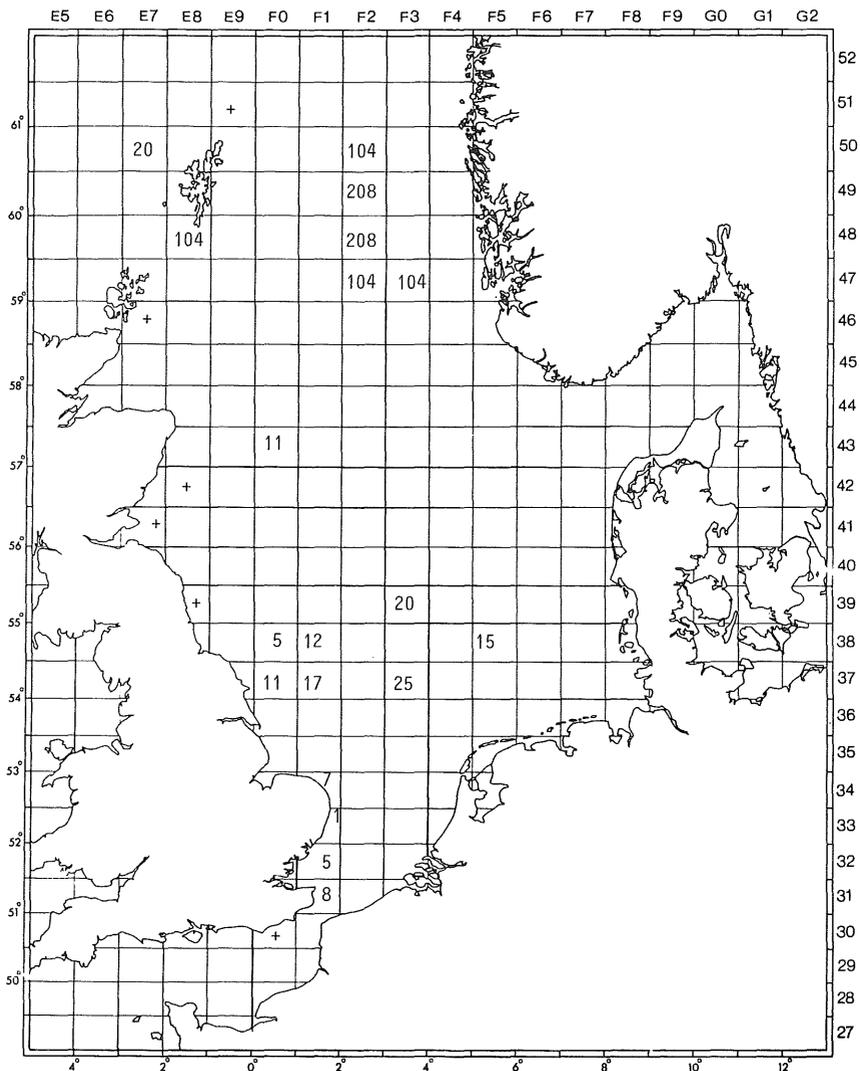
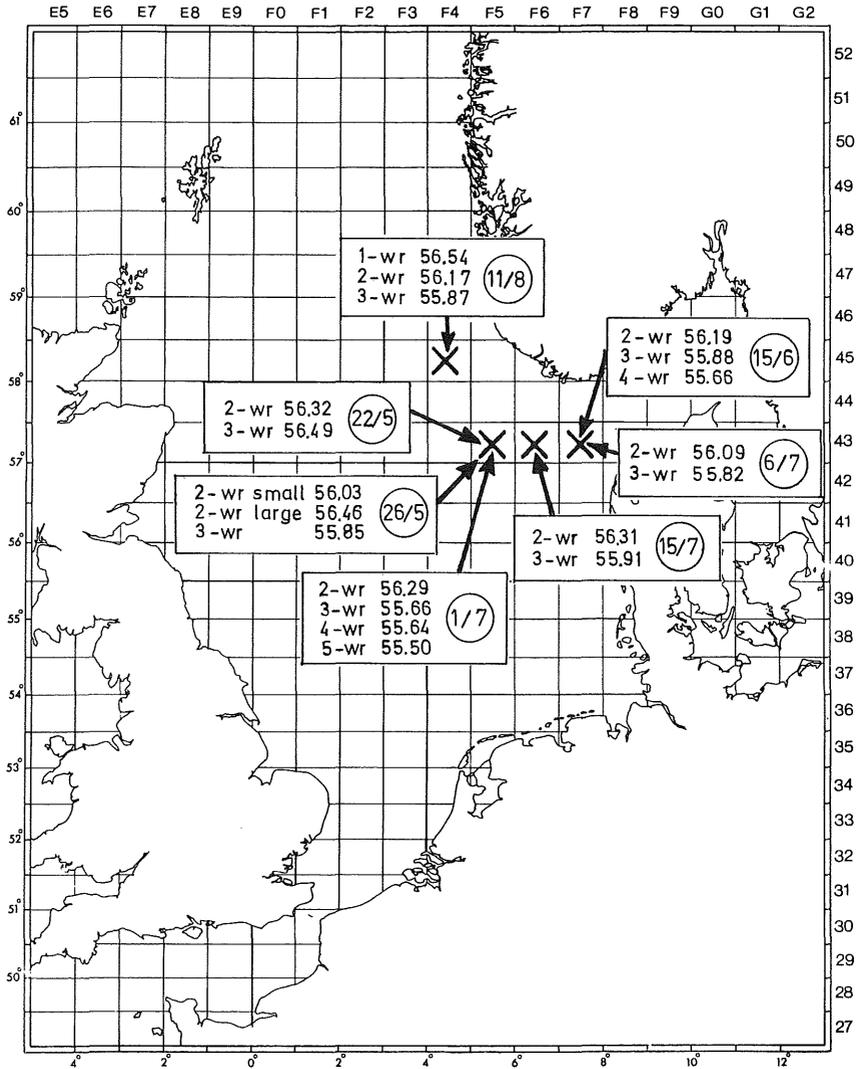
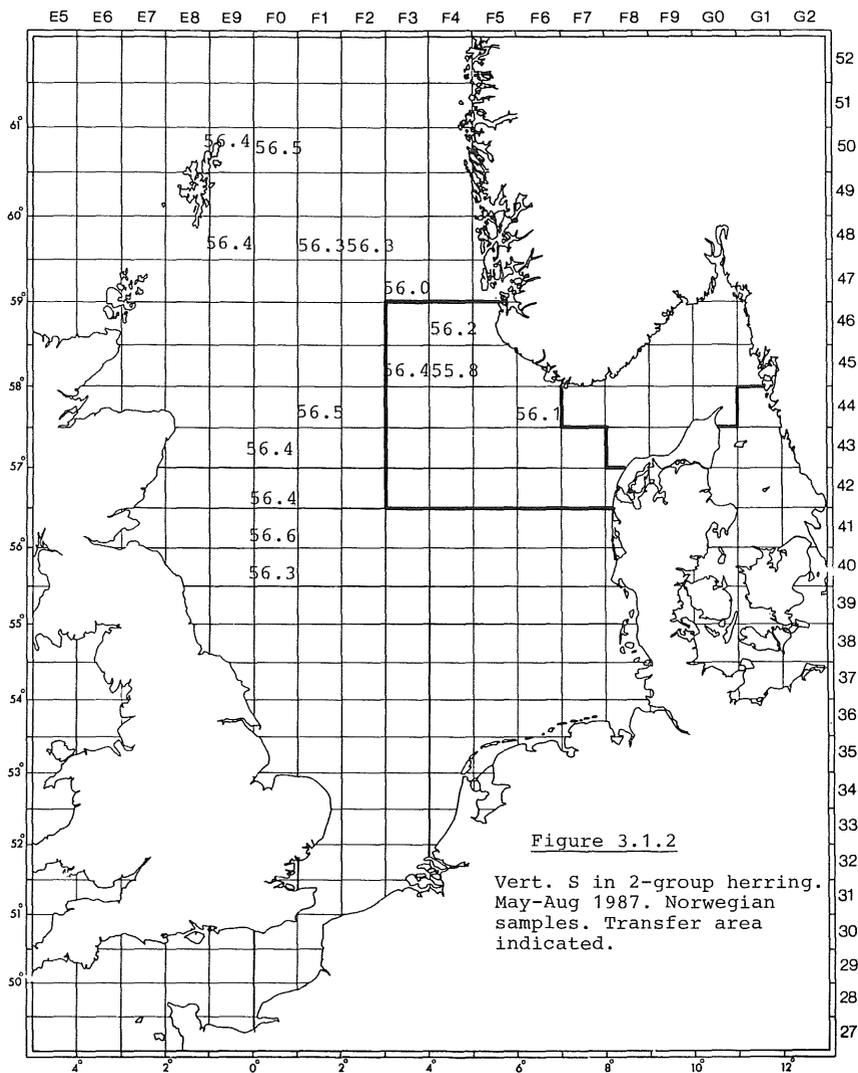
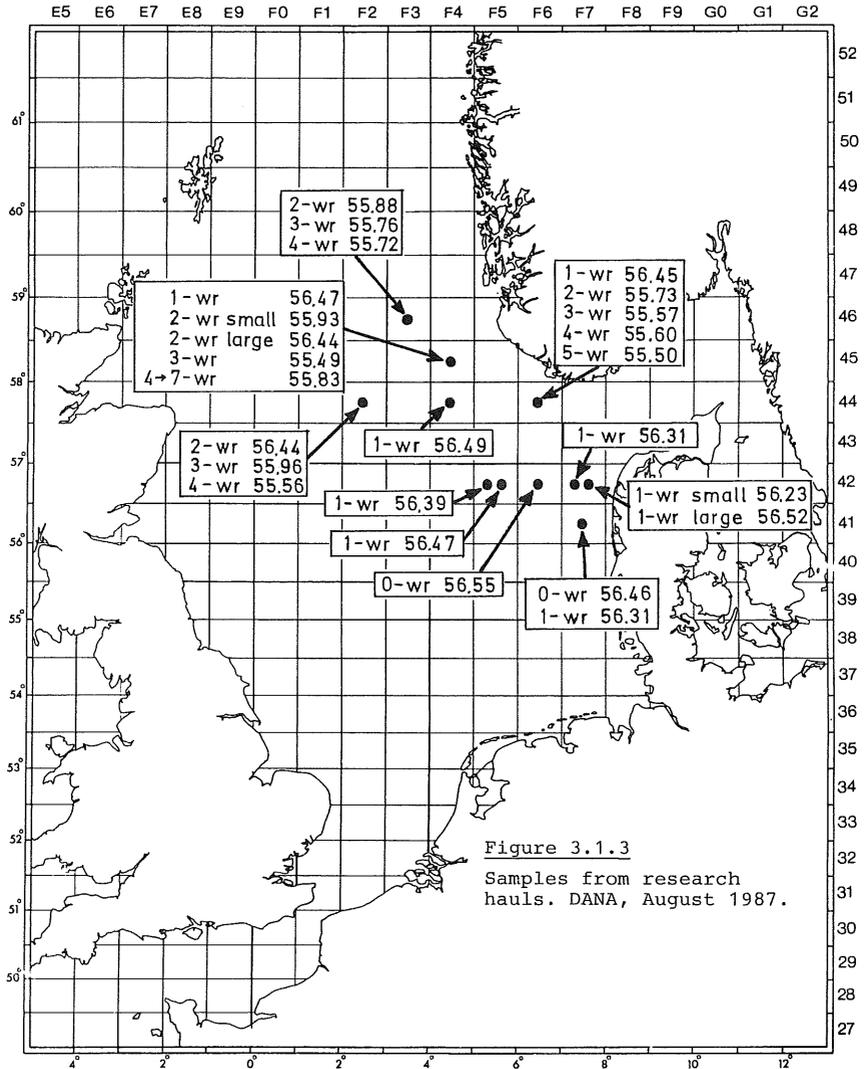


Figure 3.1.1 Danish commercial samples 1987. Mean VS at age.







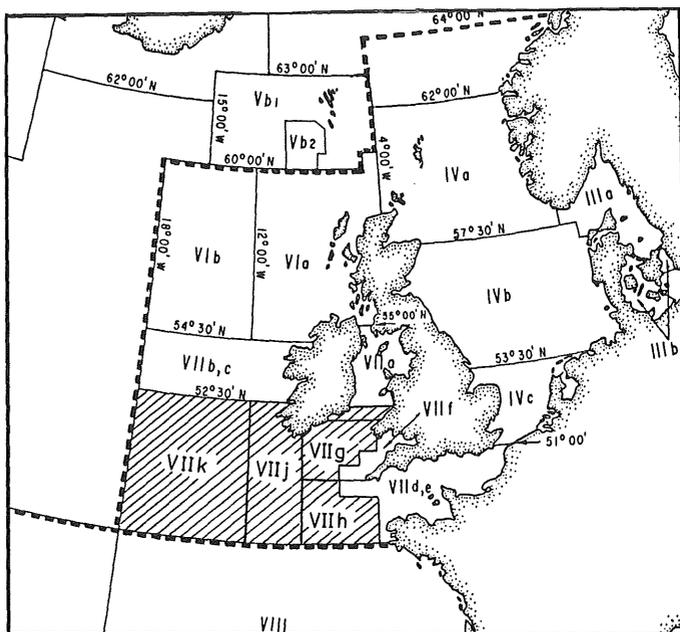


Figure 4.1.1 The assessment covers the area Divisions VIIj and VIIg and that part of Division VIIa below 52°30'. TAC is set by EC for Divisions VIIg-k and that section of Division VIIa below 52°30'.

Figure 4.5.1 Celtic Sea herring.

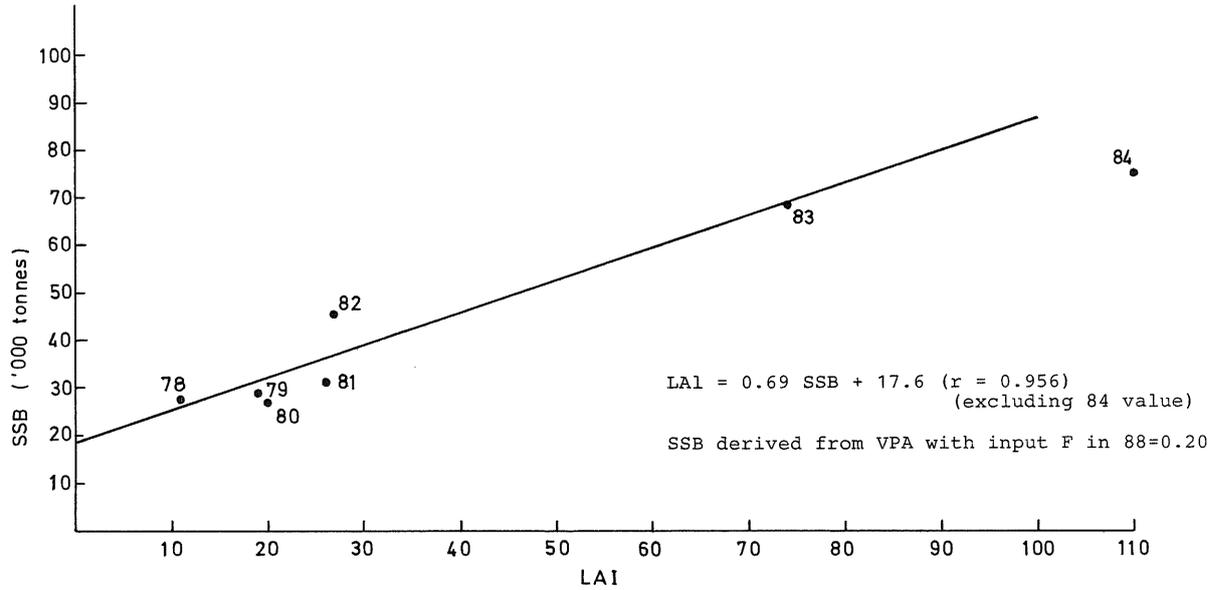


Figure 5.1.1 Herring in Division VIa North. Larval abundance indices plotted against SSB estimates from VPA.

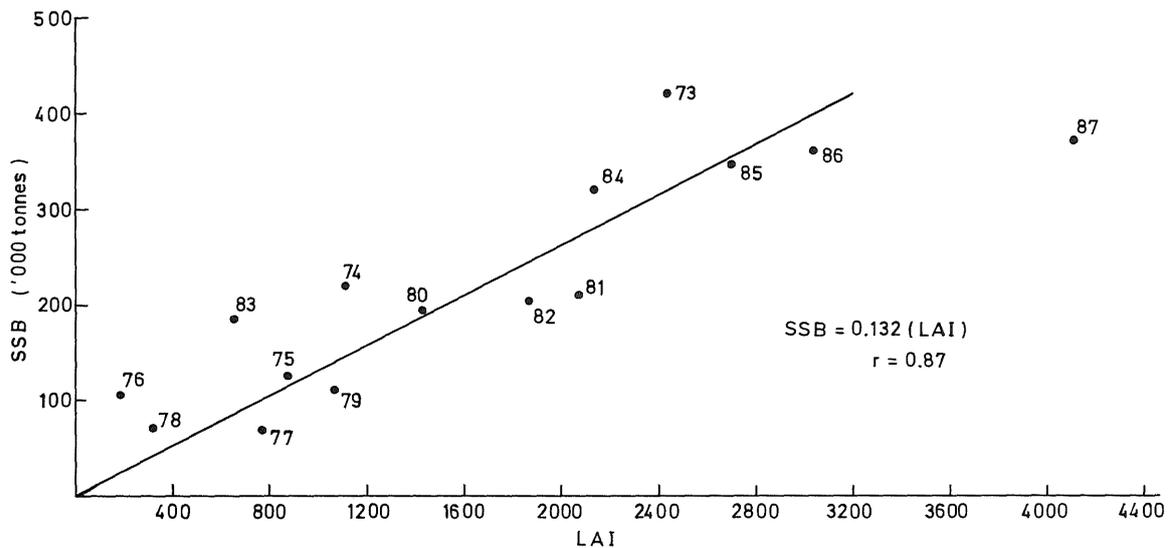
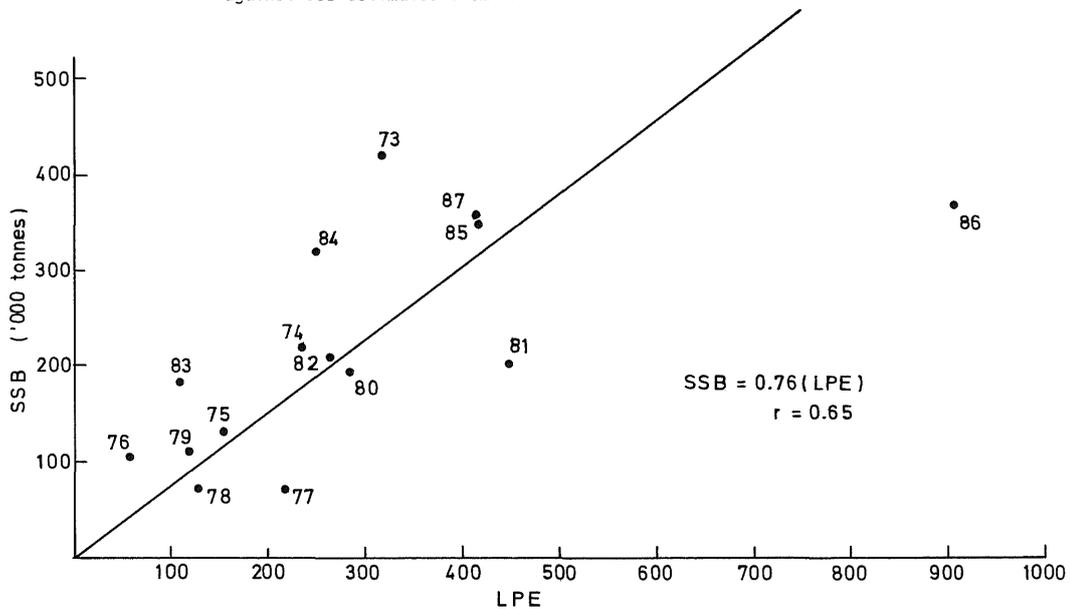


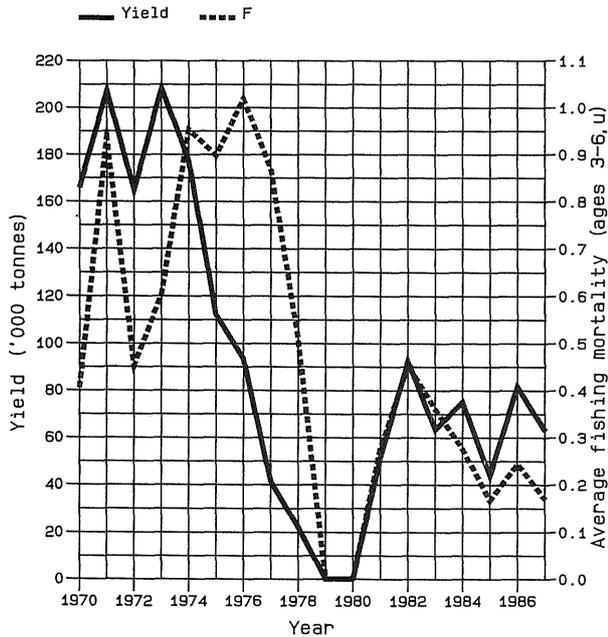
Figure 5.1.2 Herring in Division VIa North. Larval production estimates plotted against SSB estimates from VPA.



FISH STOCK SUMMARY
 STOCK: Herring - Via North
 21-04-1988

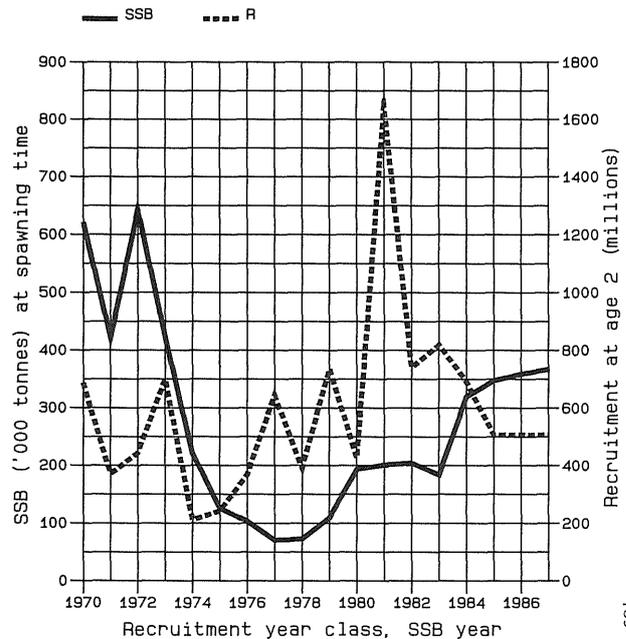
Figure 5.1.3

Trends in yield and fishing mortality (F)



A

Trends in spawning stock biomass (SSB) and recruitment (R)



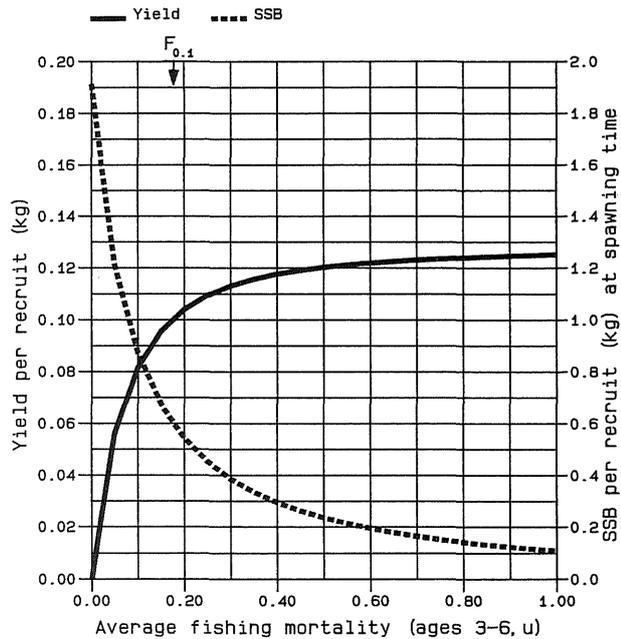
B

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FISH STOCK SUMMARY
STOCK: Herring - Via North
21-04-1988

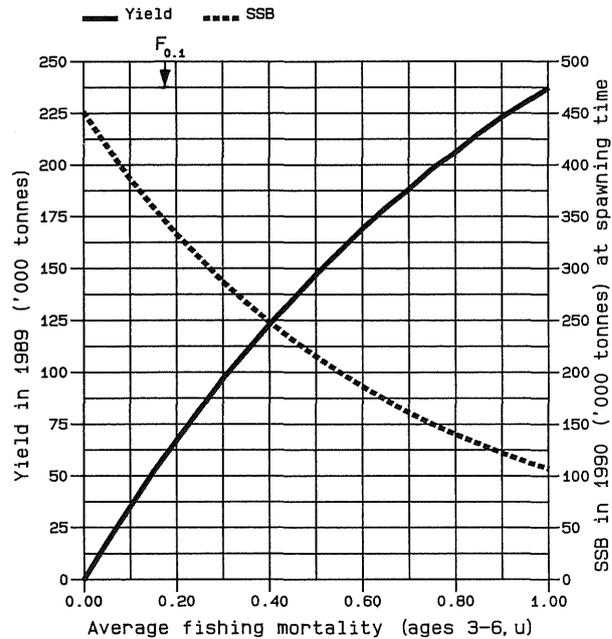
Figure 5.1.3 cont'd.

Long-term yield and spawning stock biomass



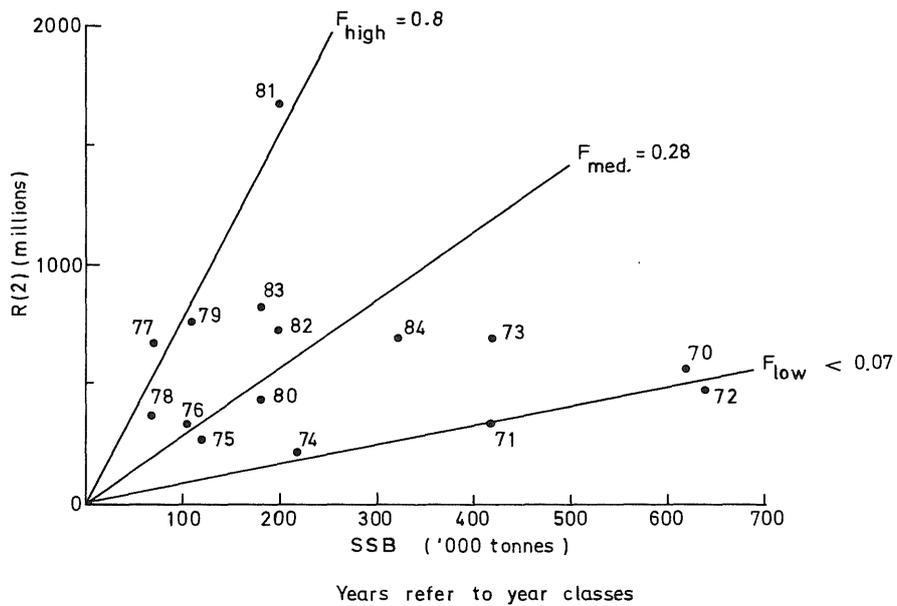
C

Short-term yield and spawning stock biomass



D

Figure 5.1.4 Herring in Division VIa North. Stock-recruitment plot with biological reference lines.



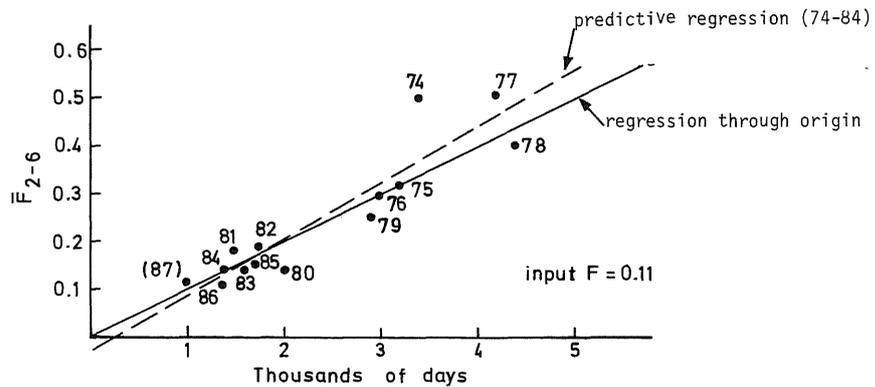
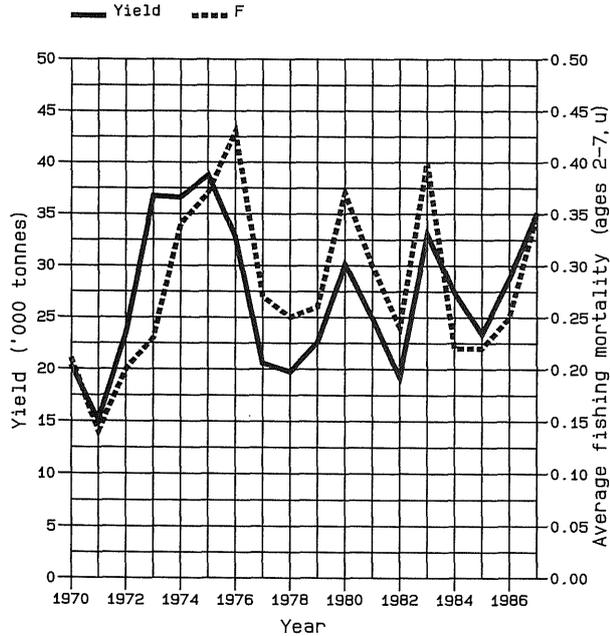


Figure 5.2.1 Scatter plot of estimated fishing mortality rates from VPA against number of days absent from port. Clyde herring.

FISH STOCK SUMMARY
STOCK: Herring - VIa (South) and VIIb,c
22-04-1988

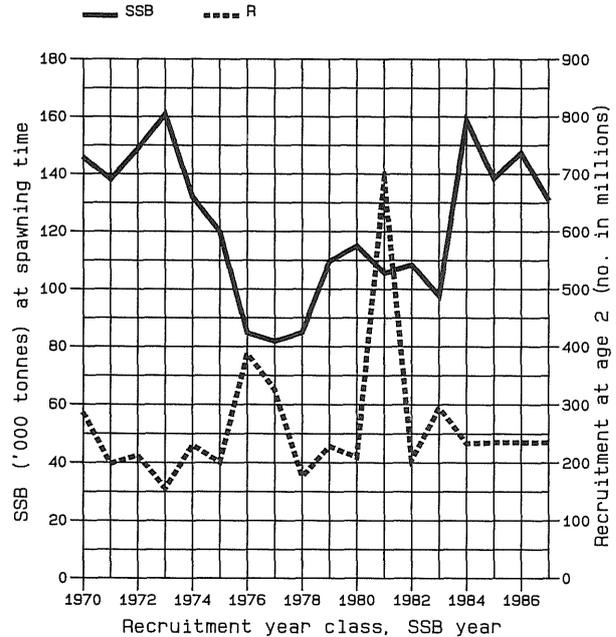
Figure 6.6.1

Trends in yield and fishing mortality (F)



A

Trends in spawning stock biomass (SSB) and recruitment (R)



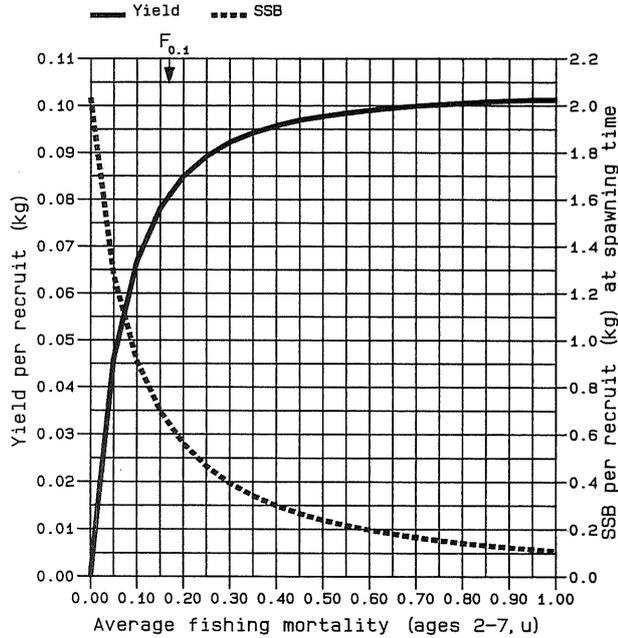
B

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FISH STOCK SUMMARY
 STOCK: Herring - VIa (South) and VIIb,c
 22-04-1988

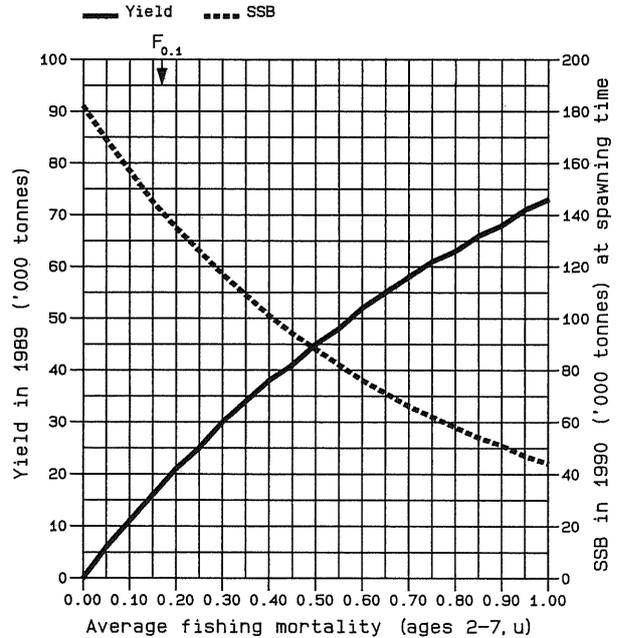
Figure 6.6.1 cont'd.

Long-term yield and spawning stock biomass



C

Short-term yield and spawning stock biomass
 Assuming catch at 14,000 t in 1988



D

cont'd.

FISH STOCK SUMMARY
 STOCK: Herring - VIa (South) and VIIb,c
 22-04-1988

Figure 6.6.1 cont'd.

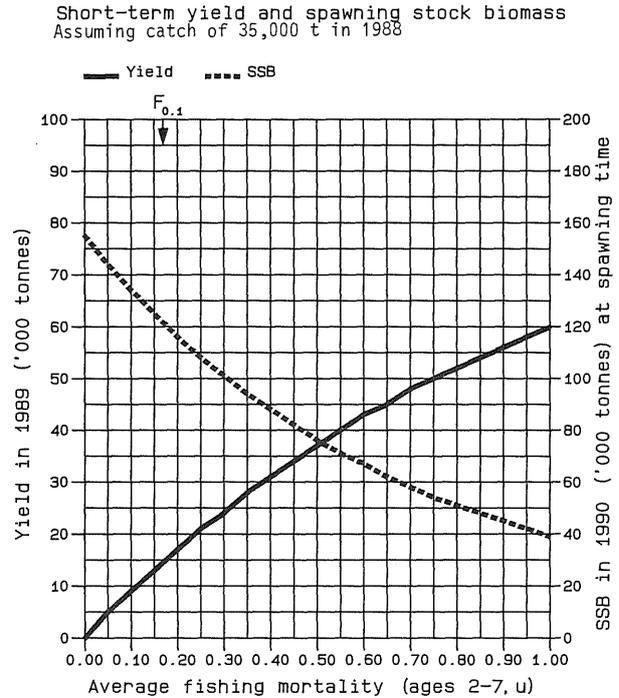


Figure 6.4.1 Divisions Via S-VIIb. Comparison of trends between larval abundance trends and spawning stock biomass estimated from VPA with different input F values in 1987. LAI underestimated in 1987.

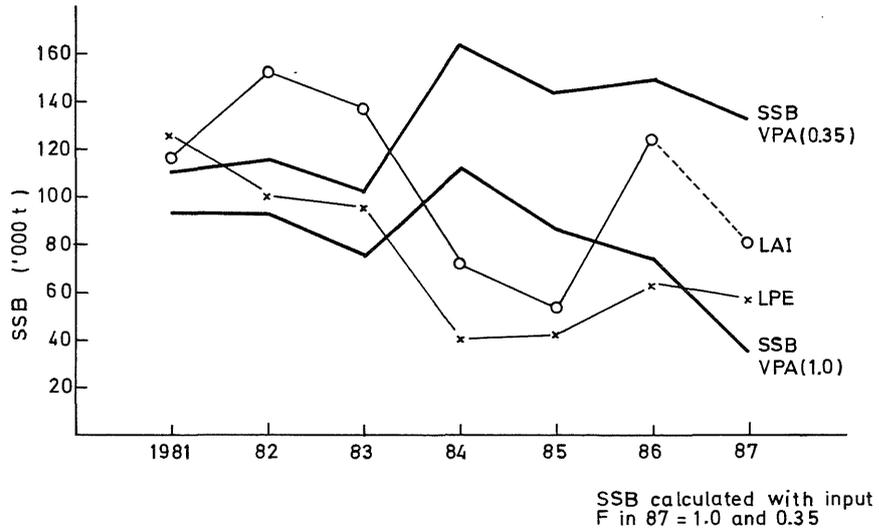


Figure 6.4.2 Comparison between trends in larval survey indices and SSB from VPA (input $F = 0.38$) in 1987. Divisions VIaS, VIIb.

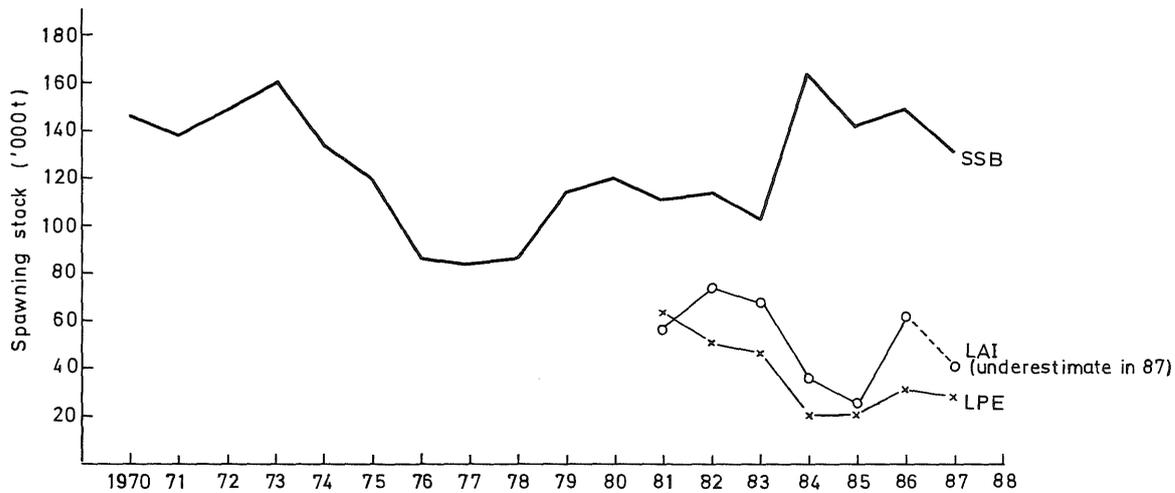
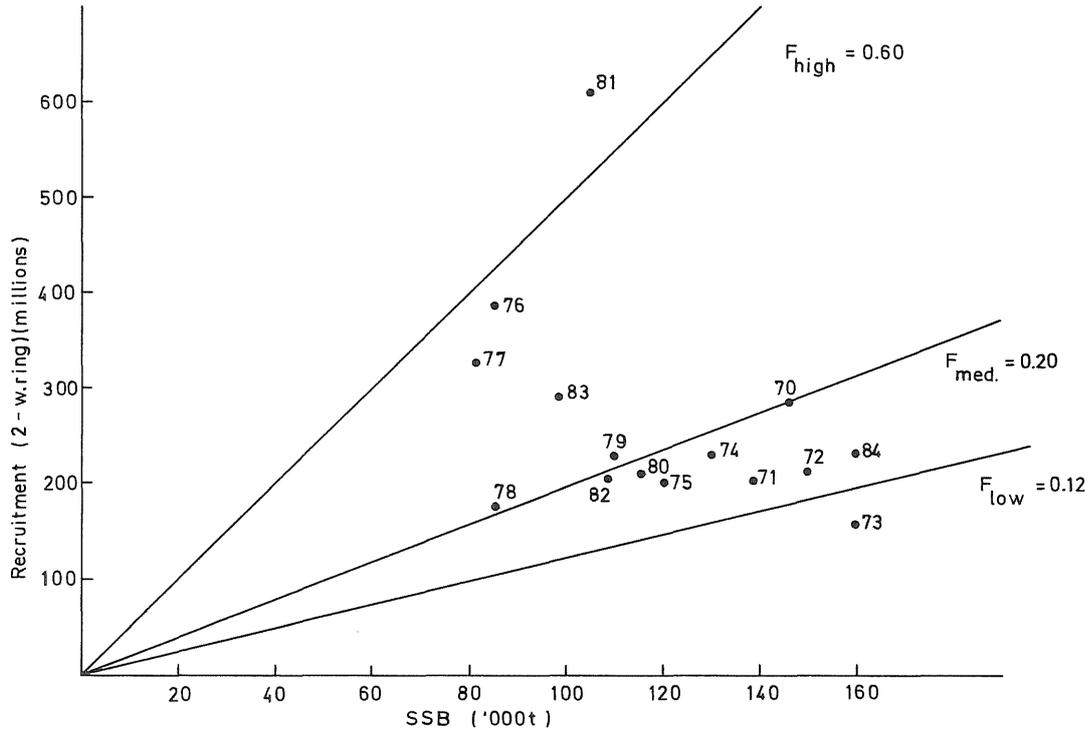


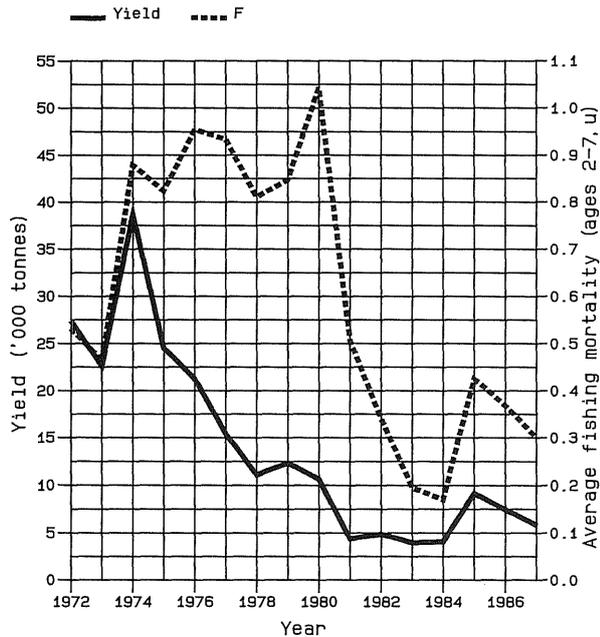
Figure 6.7.1 Divisions VIaS, VIIb. Stock-recruitment scatter plot.



FISH STOCK SUMMARY
STOCK: Herring - Northern Irish Sea
22-04-1988

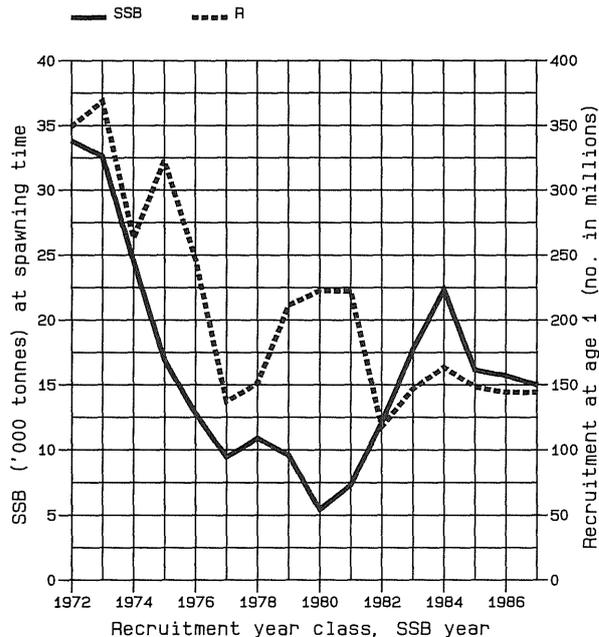
Figure 7.3.1

Trends in yield and fishing mortality (F)



A

Trends in spawning stock biomass (SSB) and recruitment (R)



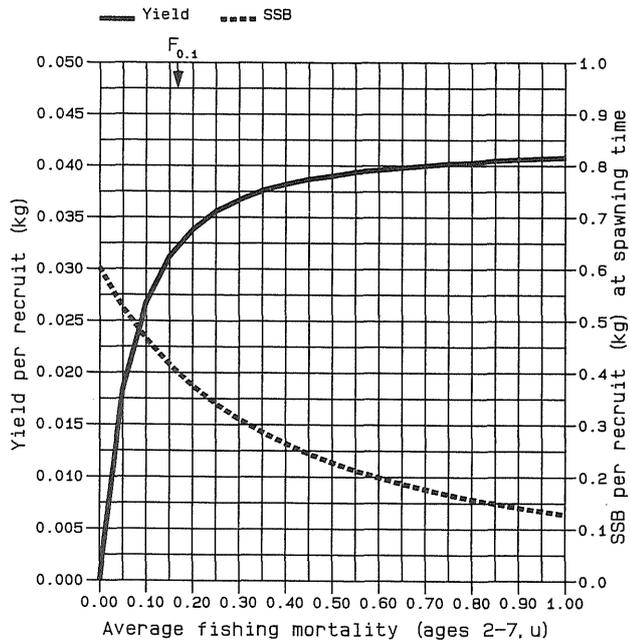
B

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FISH STOCK SUMMARY
 STOCK: Herring - Northern Irish Sea
 22-04-1988

Figure 7.3.1 cont'd.

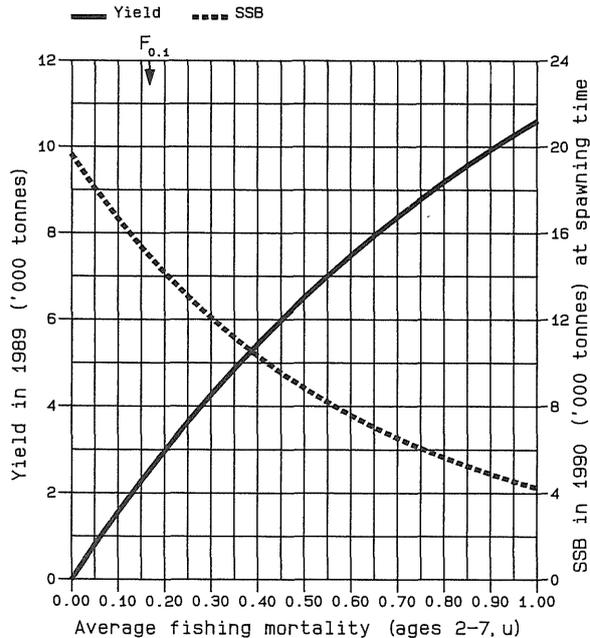
Long-term yield and spawning stock biomass



C

Short-term yield and spawning stock biomass

Assuming catch at 10,500 t in 1988



D

cont'd.

FISH STOCK SUMMARY
 STOCK: Herring - Northern Irish Sea
 22-04-1988

Figure 7.3.1 cont'd.

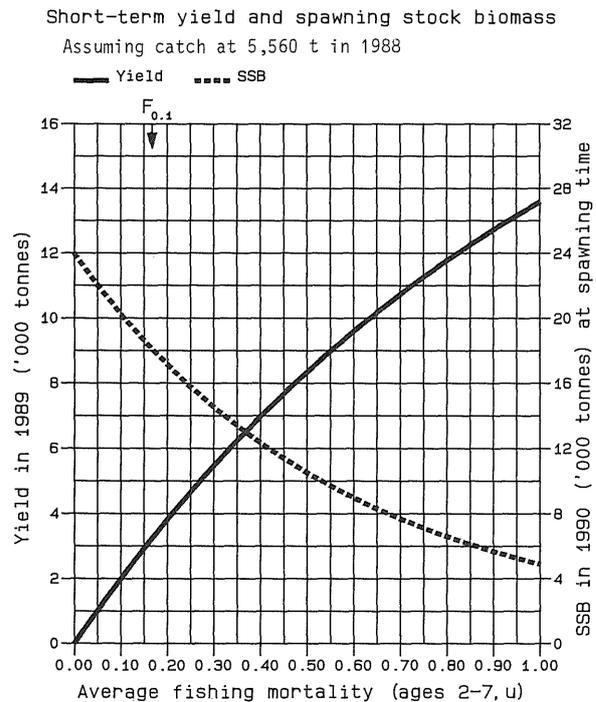
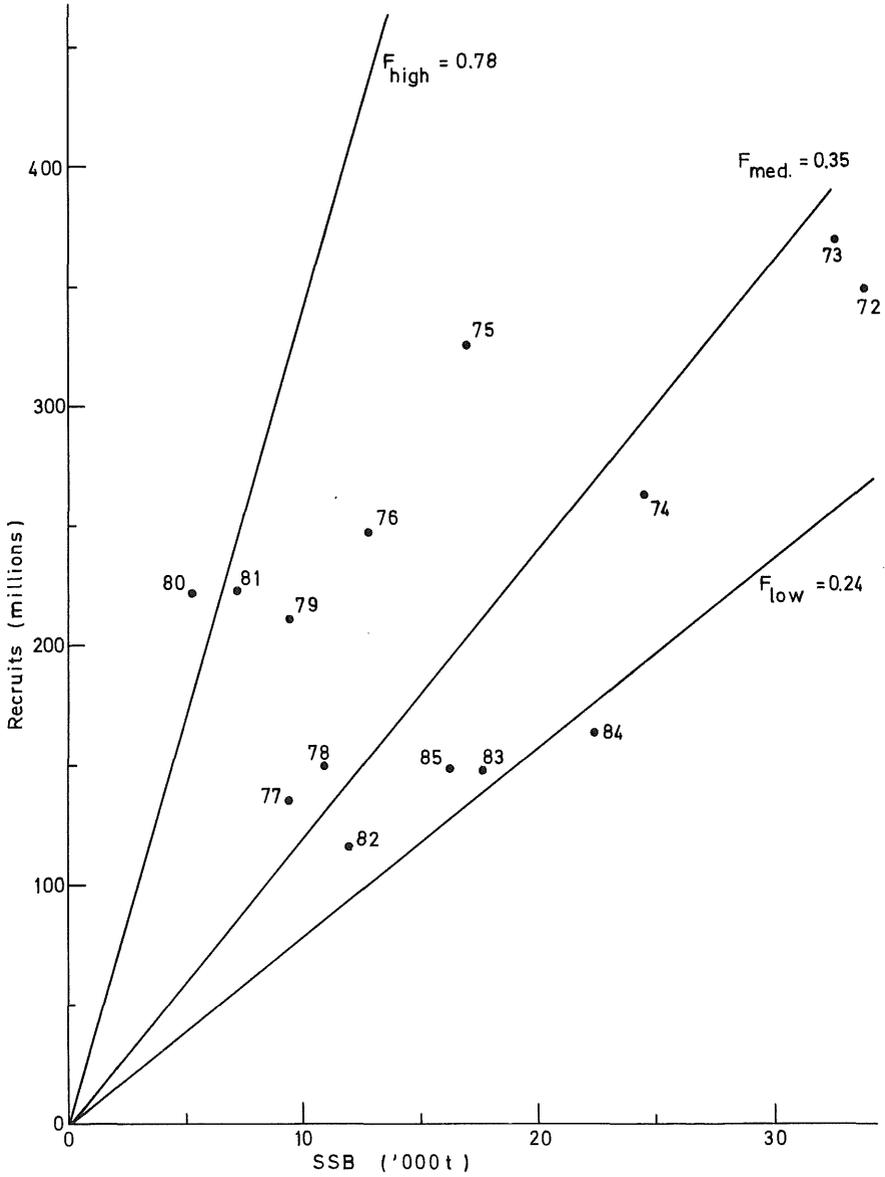


Figure 7.3.2 North Irish Sea herring (Division VIIa).
SSB: Recruit plot using $F = 0.3$.



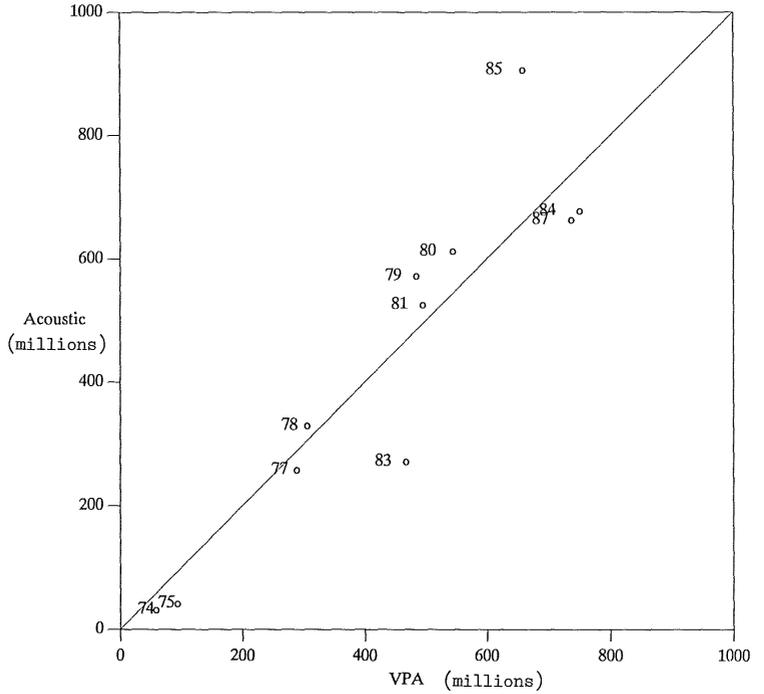


Figure 8.3.1 Comparison of acoustic estimates and VPA (4-ringers and older), where the fishing mortality rate in 1987 is 0.36 for 6-ringers and older herring.

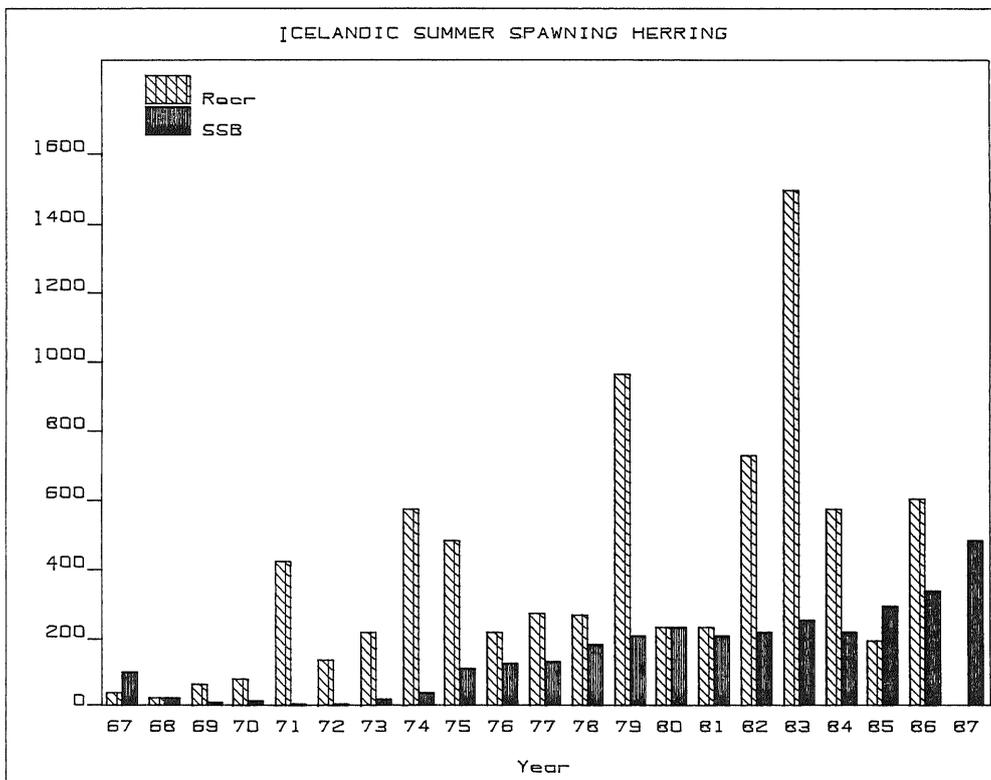
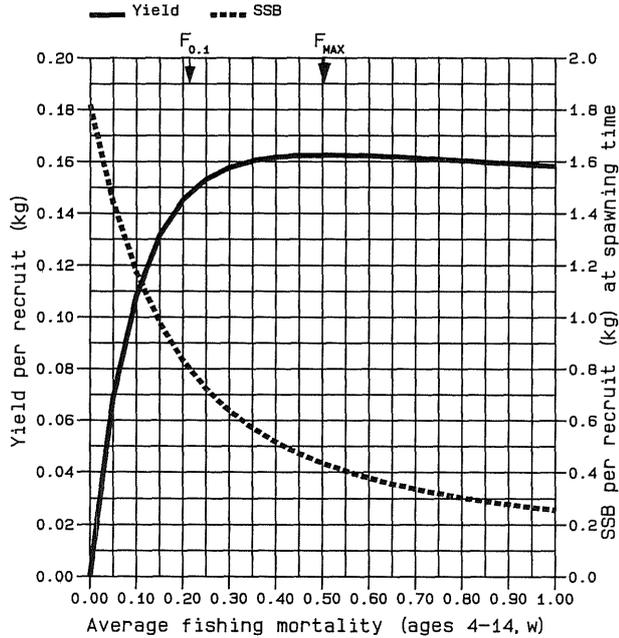


Figure 8.3.2 Trends in spawning stock biomass (SSB) and recruitment (Recr) for the Icelandic summer-spawning herring. Recruitment, year class as number of 1-ringers (millions). SSB, year in '000 t.

FISH STOCK SUMMARY
 STOCK: Herring - Va (Summer)
 22-04-1988

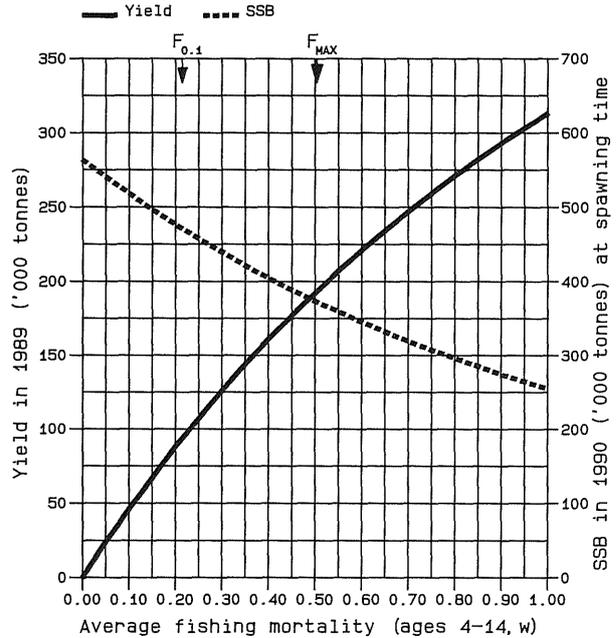
Figure 8.4.1

Long-term yield and spawning stock biomass



C

Short-term yield and spawning stock biomass



D

