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Exploration of the Sea

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REPORT OF THE SAITHE (COALFISH) WORKING GROUP

Charlottenlund, 14-18 February 1977

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Note: See also Doc. C.M.1977/F:3 - Appendix

Report of the Saithe (Coalfish) Working Group

1. Participants

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K Hoydal	Denmark (Faroe Islands)
T Jakobsen (Chairman)	Norway
J Janusz	Poland
B W Jones	United Kingdom (England)
H Knudsen	Denmark
S Munch Petersen	Denmark
S Myklevoll	Norway
H H Reinsch	Germany, Fed.Rep. of
J Richards	United Kingdom (Scotland)
S A Schopka	Iceland
B Vaske	German Democratic Republic

ICES Statistician, Dr V M Nikolaev, also participated in the meeting.

2. Terms of Reference

At the 64th Statutory Meeting of ICES it was decided (C.Res.1976/2:27) that:

"the Saithe (Coalfish) Working Group should meet at Charlottenlund from 14-18 February 1977 to assess TACs for 1978".

In addition, following the NEAFC request from the November 1976 Mid-term Meeting, the Working Group was requested by the Chairman of the Liaison Committee of ICES to provide a description of life histories, fisheries and distributions of the stocks in relation to zones under national fisheries jurisdiction for Saithe, Dogfishes and Sharks in the ICES Area.

In an understanding with the Chairman of the North Sea Roundfish Working Group Pollack was also included in the additional terms of reference.

3. Landings

Since the last meeting of the Working Group, Denmark had made estimates of landings of saithe taken as by-catches in the industrial trawl fisheries in the North Sea. These estimates, together with revised data for landings from fisheries for human consumption, were as follows:

Year	Industrial fisheries	Human consumption fisheries	Total
1970	58 700	4 600	63 300
1971	34 700	11 500	46 200
1972	22 600	17 000	39 600
1973	24 400	10 100	34 500
1974	38 800	8 300	47 100
1975	27 800	10 200	38 000
1976	53 594	12 479	66 073

The landings from the industrial fisheries had not previously been included in the North Sea landings but have now been included in Tables 1 and 3.

Tables 2-6 give landings for 1966-75 and provisional data for 1976. Catches at Iceland have continued to decline due to the lower level of recruitment in recent years. In the other areas the 1973 year class appears to be very abundant and is now making an important contribution to the catches.

4. Virtual Population Analysis (VPA)

Assessments made at the previous meeting of the Working Group (ICES, Doc. C.M.1976/F:2) have been updated using provisional age composition data for 1976 with revisions, where appropriate, to the data for earlier years. The Group experienced some difficulty in preparing age compositions for the North Sea. For this area, no U.S.S.R. age composition data were available for 1976 landings which accounted for one-third (106 000 tons) of the total catch. The summed age compositions for other countries (excluding the Danish industrial catch) were raised to allow for U.S.S.R. landings. In addition, there were revisions to the Danish landings as described in Section 3. An age composition for landings from the Danish industrial fishery was available only for 1976 and consisted of fish of ages 2-4, with 3 year olds of the apparently very abundant 1973 year class predominating. For earlier years the Group considered that the best approximation would be to assume that the Danish industrial landings were composed of the same three age groups, and age compositions were generated for this fishery assuming that the relative abundance of the age groups would be the same as in U.S.S.R. landings. The resultant age compositions used as input data are given in Table 10 and corresponding data for the other areas are shown in Tables 7, 13, 16 and 19.

Estimates of fishing mortality are given in Tables 8, 11, 14, 17 and 20. These tabulations also show the values of F assumed for 1976 which were used to initiate the computation. These latter values have been based on what is known about recent trends in the fishery. For the North Sea the inclusion of Danish industrial landings created problems in estimating input values of F for 1976 for the younger age groups. The values of F assumed for the younger age groups directly influence the estimates of the abundance of the year classes most recently recruited to the fishery. The assumed value of F for 3 year olds in 1976 results in a very large estimate for the 1973 year class in the North Sea. All the indications are that this is a very abundant year class but no independent estimates of year class strength were available for comparison.

Stock size estimates from VPA are given in Tables 9, 12, 15, 18 and 21. Year class strengths at 2 years old are tabulated in Table 28. The natural mortality coefficient, M , has been taken as 0.2 throughout.

5. The State of the Stocks

5.1 North-East Arctic

Fishing mortality appears to have remained relatively stable over recent years at about $F = 0.4$ on age groups 4 and older but with a higher F ($= 0.5$) on 3 year olds. The 1973 year class is an abundant one, especially in the southern part of the area where they have been exploited as 2 and 3 year old fish in the purse-seine fisheries. Recent tagging experiments on young saithe on the Norway coast between 62°N and 65°N have given a high proportion of recaptures south of 62°N , i.e. in the North Sea statistical area.

5.2 North Sea

Problems relating to the North Sea assessment have been described above. The overall level of fishing mortality is believed to have remained relatively constant. The Danish industrial fishery by-catch in 1976 contained mainly 3 year old fish and the increase in the landings from this fishery in 1976 is likely to reflect the abundance of the 1973 year class rather than increased fishing effort as the fishery is not directed towards saithe. There were no data available to suggest that the total fishing on 3 year old fish had increased substantially in 1976 and the F values assumed for 1976 were set at a level comparable with values estimated for the preceding years using trial VPA runs. The resultant estimate of 2 year old year class strength for the 1973 year class was 934 million which is approximately double the previous largest year class.

5.3 Iceland

Again there appears to have been no major change in this fishery and fishing mortality on the fully exploited age groups is $F = 0.5$, which is slightly below the MSY level ($F = 0.55$). Year classes of 1969 and later have been less abundant than those of 1960-68, and there is no indication of any abundant year classes among those now recruiting to the fishery.

5.4 Faroe

Fishing mortality was probably at a somewhat lower level in 1976 as a result of reduced fishing by French vessels and this is likely to have reduced the fishing mortality rates on the 4 and 5 year old fish in particular.

With the current exploitation pattern, fishing mortality ($F = 0.4$) appears to be slightly below the level required to give maximum sustainable yield ($F_{MSY} = 0.5$). As in most of the other areas the 1973 year class appears to be an abundant one.

5.5 West of Scotland

Data for this fishery are less good than for the other areas. No age composition data are available for the French fishery which accounts for about two thirds of the landings. The English age compositions are used for all countries except Scotland for which separate data are available. In this area also the 1973 year class appears to be very abundant and has contributed to the increase of catch in 1976.

6. Estimation of Total Allowable Catches (TACs)

Catch prognoses have been prepared for the years 1977-79, using the data given in Tables 22-26. Average (1963-72 year classes) year class strengths have been used for the recruiting year classes for the North-East Arctic, Faroe and West of Scotland. For the North Sea, the average recruitment was determined from year classes 1962-71. For Iceland, recent year classes have been less abundant than in earlier years and prognoses have been based on recruitment averaged for year classes 1968-72. Weight at age data have been adjusted in some cases so that the sum of 1976 catch numbers x average weight gives agreement with the 1976 landed weight. In all the prognoses, except at Iceland, it has been assumed that the exploitation pattern will remain unchanged. In at least some of the areas this may not be a realistic assumption. Changes in the relative amounts of fishing by countries involved in the fisheries which may follow the change to coastal state jurisdiction could for example affect the exploitation pattern.

For all stocks it was assumed that fishing mortality in 1977 would continue at the 1976 level. For 1978 and 1979 prognoses were prepared on the basis of (a) fishing mortality remaining constant at the 1976 level and (b) fishing mortality reducing over two years to F_{MSY} if the 1976 level F exceeded F_{MSY} . The fishing mortality giving maximum sustainable yield (MSY) was obtained from the yield curves in Figure 1. These were calculated on the model in which F varies with age as described in ICES Doc. C.M.1976/F:2. The results of the prognoses are given in Table 27.

6.1 Recommendations for Total Allowable Catches (TACs)

6.1.1 North-East Arctic

In this area the level of fishing mortality is above F_{MSY} for the present exploitation pattern. The maximum mortality is experienced by three year old fish. Spawning stock biomass is becoming reduced. The Group recommends that consideration be given to reducing fishing mortality either by an overall reduction in the amount of fishing, or, what is probably preferable, by reducing fishing mortality on the younger age groups and increasing the average age at first capture. For example, by preventing capture of 2 and 3 year old fish the long-term yield could be increased by 30%. If an overall reduction in fishing were to be adopted, the TAC for 1978 would be 108 000 tons if a change to F_{MSY} was to be made in one step. This would involve a severe reduction in catches which could be lessened if F was reduced in two stages, e.g., $F = 0.4$ in 1978 and $F = 0.25$ in 1979. In this case the TAC for 1978 would be 163 000 tons. Fishing at F_{MSY} would be expected to give an average equilibrium yield of 204 000 tons (average number one year old recruits x yield per one year old recruits).

6.1.2 North Sea

As for the North-East Arctic the current fishing mortality rate is above F_{MSY} and the three and four year old fish are suffering higher mortality rates than the older age groups. In this area a large proportion of the young fish mortality is generated by industrial fisheries for other species. Again there is a need to reduce fishing mortality overall to at least F_{MSY} or to give protection to younger age groups to increase the average age of first capture. Various regulatory measures relating to industrial fisheries are being considered for implementation in 1977 but their likely effects on the saithe by-catches are unpredictable. Another problem is the actual size of the 1973 year class which is currently estimated as a very large one. However, by 1978 this year class will be past making its main contribution to the catches. If an overall reduction in fishing mortality is considered this could be spread over two years reducing F to 0.42 in 1978 and 0.35 in 1979. For this strategy the Group recommends a TAC for 1978 of 224 000 tons. The North Sea assessment did not include data for Norwegian industrial landings, and to make allowance for landings taken in this fishery the TAC could be increased by about 5 000 tons.

6.1.3 Iceland

At Iceland the saithe stock is being fished close to the F_{MSY} level and the exploitation pattern is such that there is less fishing on the younger age groups than in other stocks. The new minimum trawl cod end mesh size of 155 mm introduced in 1977 can be expected to reduce fishing mortality on the younger age groups still further. The immediate loss resulting from the mesh change is expected to be about 4%. The catch prognoses have assumed a relatively low figure for the recruiting year classes which is more consistent with the recent recruitment levels than a longer-term average which would include year classes from the period

when recruitment was at a higher level. If the fishery is maintained at the current F level, and taking into account the effects of the increased mesh size at Iceland, a TAC of 64 000 tons is recommended for 1978.

6.1.4 Faroe

This stock is being exploited at slightly below the F_{MSY} level for the current exploitation pattern. Prognoses have been calculated on the basis of F continuing at the same (F = 0.4) level or for an increase to F_{MSY} (= 0.5) in 1978. For fishing at the MSY level in 1978 it is recommended that the TAC for 1978 should not exceed 45 000 tons.

6.1.5 West of Scotland

In this area the yield per recruit is low due to the high rate of exploitation on younger fish, and while this exploitation pattern is maintained the current levels of F are above those required for MSY. There is a need to reduce fishing mortality to about half the present level or alternatively protection should be given to the younger age groups. To reduce fishing mortality rate to the MSY level it is suggested that this could be done in two stages, reducing to F = 0.45 in 1978 and to F_{MSY} = 0.3 in 1979. For this strategy a TAC for 1978 of 20 000 tons is recommended.

6.2 Summary

The following TACs are recommended for 1978:

<u>Area</u>	<u>1978 TAC</u> (in tons)
North-East Arctic	163 000
North Sea	224 000 ¹⁾
Iceland	64 000
Faroe	45 000
West of Scotland	20 000

1) Does not include any allowance for Norwegian industrial landings.

For the areas where a reduction in fishing mortality has been recommended the average equilibrium yields have been calculated for fishing mortality rates at the present and the MSY levels:

	<u>Equilibrium Yield</u>	
	<u>Present F</u>	<u>F_{MSY}</u>
North-East Arctic	182 000 tons	204 000 tons
North Sea	180 000 tons	186 000 tons
West of Scotland	19 000 tons	20 000 tons

The fishing mortality levels corresponding to F_{0.1} are close to F = 0.2 for all areas.

7. Spawning Stock Biomass

In Table 29 the calculated spawning stock biomass for each stock is given for the period 1960-77. For all stocks there has been a considerable

decline during the last five years.* However, only in the North-East Arctic has the spawning stock biomass been reduced to a level below what has previously been recorded. The rate of decline has apparently been high and this is supported by claims from Norwegian gill-net fishermen that catch per effort of spawning saithe in the Svinøy area has been severely reduced in recent years. For the other stocks, rich year classes have previously been produced at or below the present spawning stock biomass level.

* This is at least partially due to lower levels of recruitment in recent years.

Table 1. Summary of total landings of saithe from the main fishing areas (metric tons, whole weight). This table is based on the biological data supplied to the Working Group and used in the assessments. These figures differ to some extent from the official "Bulletin Statistique" data, which are used for Tables 3-7.

Year	Fishing area					Total
	NE-Arctic	IV+IIIa	Va	Vb	VI	
1960	136 006	31 515	48 120	11 845	8 349	235 835
1961	109 821	35 489	50 826	9 592	6 723	212 451
1962	122 841	24 559	50 514	10 454	7 159	215 527
1963	148 036	30 300	48 011	12 693	6 609	245 649
1964	198 110	58 669	60 257	21 893	13 596	352 525
1965	184 548	73 274	60 177	22 181	18 395	358 575
1966	201 860	95 025	52 003	25 563	18 534	392 985
1967	191 191	76 759	75 712	21 319	16 034	381 015
1968	107 181	98 179	77 549	20 387	12 787	316 083
1969	140 379	115 550	115 853	27 437	17 214	416 433
1970	260 404	222 100	116 601	29 110	14 538	642 753
1971	244 732	251 731	136 764	30 933	19 246	683 406
1972	214 386	239 731	111 301	46 580	24 003	636 001
1973	214 153	216 888	110 888	56 606	35 834	634 369
1974	261 223	269 563	97 568	46 159	35 473	709 986
1975	233 453	267 084	87 954	41 228	27 281	657 004
1976*	220 805	326 419	79 491	32 398	35 556	694 669

*Preliminary.

Table 2. Nominal catch (metric tons) of Saithe in Sub-area I and Divisions IIa and IIb, 1966 - 1976.
(Data for 1966-1975 from Bulletin Statistique)

Country	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976*
Belgium	-	-	-	-	-	-	-	-	5	47	5
Faroe Islands	-	-	-	20	1 097	215	109	7	46	28	-
France	2 987	9 472	-	193	-	14 536	14 519	11 320	7 119	3 156	1 059
German Dem. Rep.	813	304	1 248	6 744	29 200	16 840	7 474	12 015	29 466	28 517	10 266
Germany, Fed. Rep.	11 269	11 822	4 753	4 355	23 466	12 204	24 558	30 338	33 155	41 260	49 669
Netherlands	41	48	-	23	-	-	-	-	-	-	-
Norway	175 037	150 860	96 641	115 140	151 759	128 499	143 775	148 789	152 699	122 598	124 870
Poland	-	-	-	-	-	6 017	1 111	23	2 521	3 860	3 164
Portugal	-	-	-	-	-	-	-	-	-	6 430	5 000 ^{b)}
Spain	-	-	-	-	-	13 097	9 247	2 115	7 075	11 397	10 000 ^{b)}
Sweden	-	-	-	-	-	-	-	-	-	8 ^{a)}	-
U.K. (England & Wales)	13 078	8 379	8 780	13 585	15 469	10 361	8 223	6 503	3 001	2 623	4 571
U.K. (Scotland)	-	-	2	-	221	106	125	248	103	140	73
U.S.S.R.	563	441	-	-	43 550	39 397	1 278	2 411	28 931	13 389	12 128
Total	203 788	181 326	111 424	140 060	264 762	241 272	210 456	213 769	264 121	233 453	220 805

* Preliminary.

a) IIa includes smaller quantities taken in other areas than IIa, IV and IIIa,b,c,d.

b) No data. Estimated landings used in assessments.

Table 3. Nominal catch (metric tons) of Saithe in Sub-area IV and Division IIIa, 1966-1976

(Data for 1966-1975 from Bulletin Statistique)

Country	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976*
Belgium	161	74	94	135	36	44	59	55	33	81	80
Denmark ^{a)}	4 310	5 495	7 756	5 566	63 300	46 200	39 600	34 500	47 188	37 949	66 073
Faroe Islands	-	-	-	2	-	18	182	552	581	287	408
France	19 282	13 559	34 139	24 631	38 873	37 442	26 060	30 595	28 094	23 283	29 753
German Dem. Rep.	6 634	901	903	5 998	4 250	6 398	10 674	7 668	5 816	5 882	2 088
Germany, Fed. Rep.	7 462	7 036	6 066	7 242	6 022	4 217	8 665	12 003	20 589	18 622	36 456
Iceland	-	-	5	2	18	97	4	23	5	1	
Netherlands	8 177	13 395	16 482	18 214	20 460	18 136	12 532	9 232	14 504	8 917	8 067
Norway	14 183	10 842	8 683	8 159	11 201	15 184	23 256	15 219	9 246	12 483	34 300 ^{b)}
Poland	655	104	43	-	-	4	186	7 512	22 203	35 304	35 819
Spain	-	-	-	-	-	-	190	108	308	249	
Sweden	3 643	6 318	8 212	4 322	1 921	4 523	3 899	1 876	1 187	913	
U.K. (England & Wales)	6 172	5 408	3 925	3 819	2 664	3 162	3 744	3 378	4 353	3 472	6 335
U.K. (Scotland)	3 254	3 911	6 001	3 838	5 293	6 106	10 797	10 834	10 956	8 898	13 034
U.S.S.R.	22 388	11 527	11 405	32 830	68 062	110 200	99 883	83 333	104 500	110 743	105 606
Total	96 321	78 570	104 074	114 758	222 100	251 731	239 731	216 888	269 563	267 084	338 019

* Preliminary

a) Data for 1970 - 1975 revised, ICES was advised that the figures for previous years were underestimated.

b) Includes 11 500 tons taken as by-catch in industrial fisheries. Not included in earlier years but estimated as 3 000 - 10 000 tons 1972-75.

Table 4. Nominal catch (metric tons) of Saithe in Division Va, 1966 - 1976
(Data for 1966-1975 from Bulletin Statistique)

Country	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976*
Belgium	2 282	2 739	3 155	3 995	4 153	3 490	2 250	2 131	2 371	1 638	1 364
Faroe Islands	100	39	101	119	2 386	2 046	857	1 467	1 712	1 366	3 267
France	500	5 803	6 701	8 122	2 046	3 951	-	-	62	30	-
German Dem. Rep.	154	202	634	357	3 527	2 637	3 471	-	-	-	-
Germany, Fed. Rep.	17 204	24 037	17 327	34 732	27 806	40 628	30 918	38 565	18 627	13 820	13 857
Iceland	21 022	29 021	38 027	53 988	63 882	60 080	59 945	56 567	65 169	61 430	54 547
Netherlands	25	-	-	52	-	-	-	-	-	-	-
Norway	-	-	-	-	-	-	-	-	-	-	5
Poland	-	-	-	-	-	113	150	-	-	-	-
Spain	-	-	-	-	-	59	-	-	-	-	-
U.K. (England & Wales)	9 857	13 694	11 561	13 665	10 634	21 767	13 152	11 874	8 845	8 643	6 008
U.K. (Scotland)	920	901	982	1 605	2 402	1 743	545	509	731	1 021	443
U.S.S.R.	258	35	90	65	-	5	-	-	-	-	-
Total	52 322	76 471	78 578	116 700	116 836	136 519	111 288	111 113	97 517	87 954	79 491

* Preliminary.

Table 5. Nominal catch (metric tons) of Saithe in Division Vb, 1966 - 1976
(Data for 1966-1975 from Bulletin Statistique)

Country	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976*
Faroe Islands	1 167	2 242	2 629	4 835	2 694	5 653	5 646	2 973	3 726	2 517	2 444
France	9 967	5 555	424	7 899	11 036	10 621	28 346	22 241	19 428	23 630	15 210
German Dem. Rep.	66	193	-	-	-	-	-	-	130	26	-
Germany, Fed. Rep.	4 963	5 797	7 433	4 676	2 211	2 254	3 440	9 329	6 661	5 229	2 319
Netherlands	-	-	-	-	-	63	-	-	-	491	278
Norway	2 498	-	-	378	1 495	1 839	470	355	1 660	486	2 250
Poland	-	-	-	-	-	-	-	4 050	1 925	815	1 007
Spain	-	-	-	-	-	-	423	390	500	654	-
U.K. (England & Wales)	3 321	3 536	5 123	4 303	3 066	3 305	2 453	7 527	3 827	2 428	3 033
U.K. (Scotland)	3 581	3 996	4 778	5 346	8 608	7 198	6 225	10 131	8 302	4 950	5 857
Total	25 563	21 319	20 387	27 437	29 110	30 933	47 003	56 996	46 159	41 226	32 398

* Preliminary.

Table 6. Nominal catch (metric tons) of Saithe in Sub-area VI, 1966 - 1976

(Data for 1966-1975 from Bulletin Statistique)

Country	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976*
Belgium	168	31	27	40	34	29	125	191	209	21	80
Faroe Islands	-	-	-	-	-	-	-	4	6	6	+
France	7 550	7 092	3 481	8 109	5 140	3 300	6 268	20 972	21 681	16 284	26 802
German Dem Rep.	25	-	283	-	-	-	-	-	-	8	
Germany, Fed. Rep.	62	368	368	1 988	545	1 068	350	52	16	481	534
Iceland	-	-	-	-	1	1	-	+	-	+	
Netherlands	+	54	59	14	7	32	638	67	124	702	640
Norway	-	-	-	-	-	-	-	2	22	10	-
Poland	-	-	1	-	-	2	-	394	125	164	91
Spain	-	-	-	-	-	-	1 302	1 980	1 862	1 882	
U.K. (England & Wales)	7 693	5 796	5 704	4 015	3 615	1 965	2 268	2 138	1 333	1 571	1 548
U.K. (N. Ireland)	31	17	21	13	19	24	6	14	3	12	-
U.K. (Scotland)	3 005	2 676	2 483	3 035	5 175	4 620	6 706	11 330	9 527	6 131	5 796
U.S.S.R.	-	-	-	-	-	105	112	670	269	15	62
Total	18 534	16 034	12 787	17 214	14 536	11 146	17 775	37 814	35 177	27 287	35 556

* Preliminary.

Table 7. North-East Arctic Saithe.
Age compositions of catches 1967-76 used as input data
for Virtual Population Analysis (thousands of fish).

Age group	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976
1	1	281	110	1	497	1	194	1	1	49
2	6 952	5 297	4 090	25 952	19 842	11 608	13 840	21 248	81 601	50 717
3	29 664	25 196	77 333	43 540	77 019	65 192	73 366	37 178	60 832	98 160
4	24 836	18 384	11 949	62 846	59 280	52 551	25 053	45 437	11 691	25 649
5	35 956	5 101	16 939	13 987	26 961	29 617	28 027	16 472	16 366	9 005
6	4 125	8 282	4 747	16 189	9 556	10 615	16 352	21 192	4 436	12 535
7	5 616	787	4 798	5 122	9 592	5 832	6 646	12 516	7 808	4 140
8	2 916	1 913	1 126	7 950	2 901	3 667	3 558	4 503	6 789	3 033
9	1 413	900	1 711	2 504	4 352	1 954	2 765	3 041	2 914	2 308
10	1 397	577	675	3 697	2 195	2 229	2 383	2 335	2 350	1 467
11	849	391	202	1 096	3 136	1 294	1 438	1 275	1 937	830
12	629	239	140	757	1 303	840	682	1 359	1 245	632
13	550	141	31	323	354	350	776	370	459	397
14	408	131	48	276	232	273	454	243	260	208

Table 8. North-East Arctic Saithe.
 Estimates of fishing mortality coefficients for 1967-75
 calculated by Virtual Population Analysis, and values
 assumed for 1976.

Age group	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976
1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2	0.04	0.02	0.01	0.08	0.10	0.04	0.12	0.11	0.24	0.20
3	0.18	0.21	0.34	0.18	0.35	0.54	0.40	0.52	0.49	0.50
4	0.34	0.16	0.15	0.51	0.41	0.42	0.41	0.46	0.30	0.40
5	0.45	0.11	0.22	0.25	0.43	0.37	0.42	0.52	0.30	0.40
6	0.16	0.17	0.14	0.35	0.28	0.30	0.36	0.65	0.25	0.40
7	0.19	0.04	0.14	0.22	0.36	0.27	0.32	0.51	0.53	0.40
8	0.19	0.09	0.08	0.37	0.19	0.22	0.26	0.37	0.58	0.40
9	0.21	0.08	0.11	0.25	0.36	0.18	0.26	0.38	0.43	0.40
10	0.36	0.12	0.08	0.36	0.36	0.32	0.35	0.37	0.57	0.40
11	0.32	0.16	0.06	0.19	0.59	0.38	0.35	0.33	0.60	0.40
12	0.65	0.14	0.08	0.32	0.36	0.31	0.35	0.64	0.61	0.40
13	0.39	0.29	0.02	0.26	0.24	0.15	0.52	0.33	0.47	0.40
14	0.30	0.15	0.15	0.30	0.30	0.30	0.30	0.30	0.40	0.40

Table 9. North-East Arctic Saithe.
 Estimates of stock size 1967-76 calculated by
 Virtual Population Analysis (thousands of fish).

Age group	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976
1	445 954	430 225	466 486	282 123	380 053	169 305	283 485	516 777	375 795	54 089
2	185 805	365 115	351 985	381 827	230 982	310 712	138 614	231 923	423 100	307 674
3	195 505	145 849	294 147	284 487	289 200	171 217	243 911	101 010	170 722	272 984
4	94 181	133 351	96 730	171 364	193 707	167 601	81 813	133 862	49 401	85 272
5	109 471	54 800	92 617	68 428	84 009	105 406	90 079	44 505	68 867	29 938
6	30 089	57 386	40 267	60 584	43 443	44 601	59 708	48 608	21 685	41 673
7	36 076	20 918	39 524	28 690	35 062	26 975	26 975	34 201	20 856	13 764
8	18 337	24 479	16 416	28 035	18 879	20 092	16 841	16 113	16 791	10 083
9	8 185	12 387	18 316	12 425	15 816	12 844	13 150	10 588	9 149	7 673
10	5 122	5 429	9 330	13 453	7 920	9 041	8 756	8 280	5 939	4 877
11	3 434	2 939	3 925	7 030	7 695	4 513	5 399	5 029	4 682	2 759
12	1 442	2 049	2 054	3 031	4 769	3 494	2 534	3 129	2 972	2 101
13	1 867	618	1 462	1 555	1 801	2 734	2 106	1 462	1 347	1 320
14	1 728	1 035	379	1 169	983	1 156	1 923	1 029	864	692

Table 10. North Sea Saithe.
Age compositions of catches 1967-76 used as input
data for Virtual Population Analysis (thousands of fish).

Age group	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976
1	1	130	1 628	626	390	456	4 180	3 539	311	578
2	7 606	5 615	19 813	2 852	10 147	20 248	29 854	14 506	67 473	25 104
3	13 874	15 409	19 285	37 117	68 102	38 755	44 262	58 469	45 750	211 657
4	12 787	19 025	12 488	74 994	53 348	106 058	30 178	30 682	21 263	38 807
5	13 104	9 668	9 889	12 391	30 131	23 053	24 425	12 435	8 972	8 155
6	2 085	5 725	6 045	10 874	3 717	20 763	15 158	20 603	6 684	5 617
7	1 450	571	3 952	3 779	3 874	3 624	7 960	14 510	12 623	4 652
8	470	446	730	1 996	2 682	3 104	1 776	5 030	8 603	6 395
9	294	346	489	600	1 808	1 896	1 251	1 427	3 286	3 786
10	143	164	192	326	403	1 107	1 012	810	1 097	2 072
11	82	123	62	86	223	264	572	413	614	827
12	43	70	40	59	51	125	257	223	254	569
13	19	69	33	26	18	25	80	132	279	196
14	33	53	23	26	18	68	36	30	77	178

Table 12. North Sea Saithe.
 Estimates of stock size 1967-76 calculated by
 Virtual Population Analysis (thousands of fish).

Age group	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976
1	446 723	466 640	605 588	253 828	247 778	255 244	295 685	1 144 450	355 254	64 081
2	134 275	365 745	381 936	494 343	207 251	202 511	208 564	238 312	933 802	290 576
3	123 578	103 072	294 376	294 822	402 158	160 525	147 547	143 867	182 025	703 666
4	68 623	88 672	70 510	223 615	207 934	267 951	96 597	81 081	65 481	107 923
5	49 414	44 677	55 489	46 489	115 848	122 315	124 467	52 015	38 912	34 543
6	10 373	28 687	27 884	36 530	26 932	67 781	79 399	79 930	31 410	23 793
7	5 366	6 617	18 337	17 394	20 149	18 702	36 865	51 367	46 932	19 705
8	2 173	3 091	4 902	11 459	10 843	13 011	12 051	23 025	29 029	27 088
9	1 591	1 356	2 129	3 356	7 585	6 467	7 863	8 267	14 328	16 037
10	609	1 038	799	1 303	2 208	4 585	3 593	5 311	5 484	8 777
11	439	370	702	482	774	1 445	2 759	2 033	3 619	3 503
12	285	285	193	519	317	434	945	1 744	1 293	2 410
13	295	195	171	122	372	214	243	543	1 227	830
14	164	224	97	110	76	288	152	127	326	754

Table 13. Iceland Saithe.
Age compositions of catches 1967-76 used as input data
for Virtual Population Analysis (thousands of fish).

Age group	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976
2	196	1	20	18	7	49	25	111	16	28
3	1 116	836	1 572	287	476	565	219	1 269	523	312
4	3 400	2 605	4 395	5 622	3 031	3 786	1 768	3 404	2 975	3 082
5	5 591	3 563	5 706	4 999	10 221	6 524	5 155	2 348	2 462	3 019
6	4 326	6 318	6 518	6 126	6 736	8 646	7 077	3 164	1 816	2 553
7	4 931	3 207	9 136	6 178	6 694	4 178	7 372	3 452	3 472	2 153
8	1 200	3 008	2 796	5 934	5 045	3 320	2 616	3 384	2 973	2 369
9	550	621	1 843	1 689	4 272	2 098	1 635	1 303	1 424	1 522
10	330	343	461	1 191	959	1 421	871	824	841	1 071
11	169	215	100	299	887	361	412	351	322	297
12	73	103	110	171	349	328	231	141	175	189
13	104	79	32	92	96	79	80	43	99	93
14	65	41	44	70	63	68	22	13	35	67

Table 14. Iceland Saithe.
 Estimates of fishing mortality coefficients for 1967-75
 calculated by Virtual Population Analysis, and values assumed
 for 1976.

Age group	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976
2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3	0.02	0.02	0.02	0.01	0.01	0.02	0.01	0.04	0.02	0.02
4	0.07	0.05	0.11	0.09	0.07	0.12	0.10	0.18	0.14	0.15
5	0.11	0.09	0.16	0.17	0.24	0.21	0.23	0.18	0.19	0.20
6	0.24	0.17	0.25	0.26	0.37	0.32	0.37	0.22	0.21	0.30
7	0.35	0.29	0.40	0.39	0.51	0.41	0.50	0.31	0.39	0.40
8	0.32	0.37	0.44	0.50	0.65	0.52	0.48	0.46	0.49	0.50
9	0.31	0.28	0.41	0.52	0.83	0.62	0.53	0.47	0.36	0.50
10	0.30	0.33	0.34	0.51	0.64	0.75	0.57	0.55	0.65	0.50
11	0.26	0.32	0.15	0.39	0.94	0.54	0.50	0.48	0.44	0.50
12	0.19	0.25	0.27	0.41	1.12	1.20	0.81	0.32	0.47	0.50
13	0.43	0.32	0.12	0.39	0.42	0.84	1.18	0.33	0.39	0.50
14	0.30	0.30	0.30	0.40	0.50	0.60	0.60	0.60	0.50	0.50

Table 15. Iceland Saithe.
 Estimates of stock size 1967-76 calculated by
 Virtual Population Analysis (thousands of fish).

Age group	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976
2	72 307	108 257	73 999	57 166	32 281	34 937	39 994	37 155	21 244	30 908
3	67 055	59 023	88 632	60 567	46 788	26 423	28 560	32 722	30 320	17 379
4	57 282	53 892	47 569	71 147	49 329	37 877	21 124	23 185	25 645	24 352
5	59 764	43 831	41 772	34 983	53 179	37 652	27 597	15 700	15 916	18 315
6	21 901	43 889	32 672	29 060	24 139	34 343	24 955	17 956	10 739	10 814
7	18 350	14 039	30 242	20 886	18 282	13 715	20 349	14 078	11 853	7 158
8	4 754	10 595	8 611	16 562	11 555	8 972	7 480	10 056	8 424	6 588
9	2 251	2 814	5 974	4 543	8 244	4 952	4 373	3 780	5 200	4 233
10	1 404	1 348	1 745	3 237	2 207	2 943	2 178	2 116	1 927	2 978
11	800	853	796	1 015	1 584	950	1 141	1 004	995	826
12	464	503	505	562	563	508	454	565	507	526
13	326	314	319	315	306	151	125	166	336	259
14	275	174	186	233	175	165	53	31	97	186

Table 16. Faroe Saithe.
Age compositions of catches 1967-76 used as input
data for Virtual Population Analysis (thousands of fish).

Age group	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976
1	2	1	1	2	1	1	4	5	5	5
2	154	222	55	774	683	240	1 620	133	189	93
3	595	614	1 191	1 445	2 702	2 997	2 469	3 424	2 051	3 318
4	796	1 689	2 086	6 277	3 136	1 959	6 138	3 991	3 325	3 074
5	1 364	1 116	2 294	1 558	5 282	2 858	6 946	3 880	3 752	1 703
6	792	1 095	1 414	1 478	947	3 027	3 414	2 727	1 918	1 231
7	1 192	548	1 118	899	784	1 689	1 604	1 388	1 038	850
8	473	655	589	730	444	1 440	681	635	711	618
9	217	254	580	316	308	1 123	540	365	301	451
10	190	128	239	241	155	821	395	339	191	213
11	97	89	115	86	94	364	211	195	192	113
12	75	59	100	48	51	148	101	123	125	125
13	38	40	36	46	12	31	25	45	64	56
14	11	29	30	15	17	31	21	44	42	43

Table 17. Faroe Saithe.
 Estimates of fishing mortality coefficients for 1967-75
 calculated by Virtual Population Analysis, and values
 assumed for 1976.

Age group	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976
1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2	0.01	0.01	0.00	0.02	0.02	0.01	0.08	0.00	0.00	0.01
3	0.03	0.04	0.04	0.06	0.10	0.13	0.13	0.23	0.09	0.10
4	0.06	0.11	0.18	0.30	0.18	0.10	0.41	0.33	0.36	0.18
5	0.13	0.11	0.21	0.19	0.44	0.24	0.61	0.49	0.60	0.32
6	0.16	0.15	0.20	0.20	0.17	0.48	0.50	0.51	0.48	0.40
7	0.31	0.16	0.23	0.19	0.16	0.52	0.51	0.39	0.37	0.40
8	0.33	0.28	0.26	0.23	0.14	0.48	0.41	0.39	0.35	0.40
9	0.29	0.30	0.43	0.21	0.14	0.59	0.33	0.40	0.32	0.40
10	0.35	0.27	0.51	0.32	0.15	0.67	0.43	0.35	0.38	0.40
11	0.38	0.27	0.42	0.35	0.20	0.64	0.36	0.39	0.35	0.40
12	0.34	0.42	0.56	0.31	0.36	0.56	0.37	0.37	0.47	0.40
13	0.25	0.31	0.50	0.55	0.12	0.39	0.17	0.28	0.34	0.40
14	0.30	0.30	0.40	0.40	0.40	0.50	0.50	0.50	0.45	0.40

Table 18. Faroe Saithe.
Estimates of stock size 1967-76 calculated by
Virtual Population Analysis (thousands of fish).

Age group	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976
1	51 270	41 523	46 522	42 643	32 606	29 630	40 958	57 554	12 594	552
2	22 294	41 975	33 995	38 088	34 911	26 694	24 258	33 530	47 117	10 311
3	22 890	18 114	34 165	27 783	30 485	27 966	21 639	18 399	27 332	38 406
4	15 030	18 203	14 276	26 897	21 443	22 522	20 195	15 491	11 983	20 528
5	11 986	11 587	13 381	9 809	16 379	14 731	16 673	11 027	9 098	6 825
6	5 863	8 584	8 481	8 890	6 628	8 673	9 490	7 439	5 551	4 093
7	4 874	4 087	6 041	5 670	5 948	4 574	4 388	4 711	3 648	2 826
8	1 832	2 919	2 852	3 940	3 833	4 163	2 232	2 156	2 611	2 055
9	958	1 075	1 801	1 805	2 569	2 738	2 118	1 216	1 195	1 499
10	708	589	652	955	1 194	1 826	1 237	1 249	668	708
11	335	409	367	320	565	838	761	659	718	376
12	285	187	255	197	185	378	360	434	364	416
13	192	166	100	119	119	105	177	204	245	186
14	47	123	100	50	57	86	58	122	127	143

Table 19. West of Scotland Saithe.
Age compositions of catches 1967-76 used as input
data for Virtual Population Analysis (thousands of fish).

Age group	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976
1	1	2	1	1	1	79	110	600	50	289
2	385	49	337	32	371	5 309	4 093	7 233	4 097	8 481
3	2 053	2 435	1 993	2 857	1 342	4 798	9 786	8 652	6 905	17 195
4	2 885	2 287	4 643	2 335	4 305	1 868	7 820	2 868	3 489	3 201
5	1 934	1 198	1 506	1 805	1 833	1 435	1 797	1 650	1 729	2 031
6	269	621	509	599	1 051	846	1 772	872	953	823
7	454	148	571	241	450	625	855	1 073	548	194
8	91	126	106	196	350	349	496	464	701	180
9	44	29	80	41	290	256	208	435	318	164
10	28	22	22	57	50	232	158	275	200	71
11	14	11	18	20	89	84	199	307	77	72
12	11	7	8	20	21	107	48	301	76	26
13	8	4	8	12	29	31	61	40	77	29
14	6	2	4	4	10	23	27	62	28	28

Table 20. West of Scotland Saithe.
 Estimates of fishing mortality coefficients for 1967-75
 calculated by Virtual Population Analysis, and values
 assumed for 1976.

Age group	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976
1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.01
2	0.02	0.00	0.01	0.00	0.02	0.19	0.14	0.27	0.09	0.25
3	0.18	0.14	0.15	0.16	0.14	0.28	0.65	0.50	0.46	0.60
4	0.35	0.30	0.43	0.27	0.38	0.28	1.00	0.40	0.38	0.40
5	0.28	0.24	0.33	0.29	0.35	0.21	0.49	0.59	0.45	0.40
6	0.17	0.14	0.15	0.21	0.27	0.27	0.43	0.46	0.84	0.40
7	0.22	0.13	0.18	0.10	0.25	0.26	0.47	0.51	0.60	0.40
8	0.12	0.09	0.13	0.08	0.21	0.31	0.34	0.50	0.76	0.40
9	0.08	0.05	0.07	0.07	0.17	0.23	0.30	0.57	0.79	0.40
10	0.15	0.06	0.05	0.07	0.11	0.21	0.22	0.83	0.56	0.40
11	0.21	0.08	0.06	0.06	0.15	0.27	0.27	0.86	0.59	0.40
12	0.26	0.15	0.08	0.09	0.08	0.26	0.24	0.86	0.53	0.40
13	0.46	0.14	0.26	0.16	0.17	0.16	0.24	0.33	0.55	0.40
14	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.40	0.40	0.40

Table 21. West of Scotland Saithe.
Estimates of stock size 1967-76 calculated by
Virtual Population Analysis (thousands of fish).

Age group	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976
1	23 324	32 229	17 373	32 801	40 448	41 712	40 495	68 286	51 510	32 041
2	25 600	19 095	26 385	14 223	26 854	33 115	34 079	33 055	55 366	42 127
3	14 044	20 612	15 590	21 298	11 616	21 651	22 332	24 213	20 559	41 634
4	10 639	9 649	14 681	10 968	14 863	8 301	13 413	9 538	12 072	10 642
5	8 727	6 120	5 844	7 855	6 880	8 305	5 117	4 032	5 235	6 752
6	1 939	5 406	3 933	3 432	4 808	3 986	5 508	2 579	1 825	2 736
7	2 511	1 345	3 866	2 761	2 271	2 992	2 503	2 920	1 330	645
8	904	1 647	968	2 651	2 043	1 454	1 887	1 283	1 430	598
9	598	658	1 235	697	1 994	1 358	877	1 100	635	545
10	218	450	512	939	534	1 371	881	531	511	236
11	82	153	349	400	717	392	914	579	190	239
12	54	55	115	269	309	507	245	569	201	86
13	24	34	38	87	202	234	319	158	198	96
14	36	12	24	24	61	140	164	206	93	93

Table 22. North-East Arctic Saithe.
Calculation of TAC.

Age group	Stock 1977 ('000)	Proportional fishing mortality (76, 77, 78, 79)	Average weight ²⁾ (kg)
2	280 000 ¹⁾	0.4	.34
3	187 872 ¹⁾	1.0	.71
4	135 560	0.8	1.11
5	46 798	0.8	1.63
6	16 430	0.8	2.33
7	22 871	0.8	3.16
8	7 554	0.8	4.03
9	5 534	0.8	4.87
10	4 211	0.8	5.63
11	2 677	0.8	6.44
12	1 514	0.8	7.11
13	1 153	0.8	7.82
14	724	0.8	8.95
15+	380	0.8	9.5

- 1) Average recruitment for year classes 1963-72.
2) Weights adjusted to give correct 1976 catch figure.

Table 23. North Sea Saithe.
Calculation of TAC.

Age group	Stock 1977 ('000)	Proportional fishing mortality (76, 77, 78, 79)	Average weight (kg)
1	300 000 ¹⁾	0.02	0.30
2	241 175 ¹⁾	0.2	0.45
3	215 264	0.8	0.75
4	386 180	1.0	1.16
5	53 593	0.6	1.79
6	20 952	0.6	2.48
7	14 431	0.6	3.38
8	11 952	0.6	4.20
9	16 430	0.6	4.91
10	9 727	0.6	5.65
11	5 323	0.6	6.45
12	2 125	0.6	7.16
13	1 462	0.6	8.07
14	504	0.6	9.00

- 1) Based on average recruitment of year classes 1962-71.

Table 24. Iceland Saithe.
Calculation of TAC.

Age group	Stock 1977 ('000)	Proportional fishing mortality ²⁾ (76, 77, 78, 79)	Average weight (kg)
3	33 000 ¹⁾	0.02	0.89
4	26 483 ¹⁾	0.24	1.60
5	17 161	0.36	3.05
6	12 277	0.60	4.34
7	6 559	0.80	5.36
8	3 928	1.00	6.30
9	3 272	1.00	7.88
10	2 102	1.00	8.80
11	1 479	1.00	9.29
12	410	1.00	9.26
13	261	1.00	9.64
14	129	1.00	11.91

- 1) Average recruitment for the year classes 1968-72.
- 2) Exploitation pattern corrected to simulate the effects of the new mesh regulations at Iceland.

Table 25. Faroe Saithe.
Calculation of TAC.

Age group	Stock 1977 ('000)	Proportional fishing mortality (76, 77, 78, 79)	Average weight (kg)
2	29 000 ¹⁾	0.03	.67
3	19 451 ¹⁾	0.25	1.22
4	28 452	0.45	1.88
5	14 038	0.8	2.62
6	4 058	1.0	3.40
7	2 246	1.0	4.18
8	1 551	1.0	4.95
9	1 128	1.0	5.69
10	823	1.0	6.38
11	389	1.0	7.02
12	206	1.0	7.62
13	228	1.0	8.15
14	102	1.0	8.64
15+	78	1.0	10.00

- 1) Average recruitment for year classes 1964-73.

Table 26. West of Scotland Saithe.
Calculation of TAC.

Age group	Stock 1977 ('000)	Proportional fishing mortality (76, 77, 78, 79)	Average weight ²⁾ (kg)
1	30 000 ¹⁾	0.02	0.53
2	21 620	0.42	0.57
3	26 620	1.00	0.93
4	18 707	0.67	1.26
5	5 805	0.67	1.82
6	3 683	0.67	2.66
7	1 493	0.67	3.56
8	352	0.67	4.65
9	326	0.67	5.56
10	297	0.67	6.35
11	129	0.67	7.00
12	131	0.67	7.46
13	47	0.67	8.18
14	53	0.67	8.64
15	51	0.67	8.82

1) Average recruitment for year classes 1963-72.

2) Weights adjusted to give correct 1976 catch figure.

Table 27. Results of catch prognoses for Saithe.

Year	F ¹⁾	Catch (tons)	F ¹⁾	Catch (tons)	F ¹⁾	Catch (tons)
<u>NE ARCTIC</u> (Recruitment R ₂ = 280 000)						
(1976	0.5	221 000)				
1977	0.5	204 000	0.5	204 000	0.5	204 000
1978	0.5	197 000	0.4	163 000	0.25	108 000
1979	0.5	192 000	0.25	113 000	0.25	125 000
<u>NORTH SEA</u> (Recruitment R ₁ = 300 000)						
(1976	0.5	326 000)				
1977	0.5	326 000	0.5	326 000		
1978	0.5	259 000	0.42	224 000		
1979	0.5	241 000	0.35	185 000		
<u>ICELAND</u> (Recruitment R ₃ = 33 000)						
(1976	0.5	79 000)				
1977	0.5	68 000				
1978	0.5	64 000				
1979	0.5	63 000				
<u>FAROE</u> (Recruitment R ₂ = 29 000)						
(1976	0.4	32 000)				
1977	0.4	35 000	0.4	35 000		
1978	0.4	37 000	0.5	45 000		
1979	0.4	37 000	0.5	42 000		
<u>WEST OF SCOTLAND</u> (Recruitment R ₁ = 30 000)						
(1976	0.6	36 000				
1977	0.6	30 000	0.6	30 000		
1978	0.6	26 000	0.45	20 000		
1979	0.6	24 000	0.3	15 000		

1) Fishing mortality on age groups subject to maximum exploitation.

Table 28. Estimates from Virtual Population Analysis of population size (millions) at 2 years old of each year class. (Estimates of year class size of the most recent year classes are less reliable.)

Year class	NE-Arctic	North Sea	Iceland	Faroe	Scotland
1958	116	38	41	10	8
1959	229	35	39	15	9
1960	337	50	103	25	18
1961	117	67	68	18	15
1962	361	163	115	26	29
1963	204	118	87	23	20
1964	247	165	82	28	17
1965	186	134	72	22	26
1966	365	366	108	42	20
1967	352	382	74	34	26
1968	382	494	57	38	14
1969	231	207	32	35	27
1970	311	203	35	27	33
1971	139	209	40	24	34
1972	232	238	37	34	33
1973	423	934	21	47	55

Table 29. Spawning stock biomass ('000 tonnes).

	NE-Arctic	North Sea	Iceland ¹⁾	Faroe	W. of Scotland
Ages:	6+	5+	7	6+	5+
1960	334	53	122	42	19
1961	314	55	135	45	17
1962	359	51	149	51	16
1963	359	62	150	55	16
1964	351	69	151	56	20
1965	377	86	201	58	29
1966	407	96	254	67	28
1967	388	161	348	66	40
1968	438	208	421	77	47
1969	482	274	476	89	53
1970	570	313	460	95	62
1971	515	448	449	95	67
1972	470	579	394	107	69
1973	493	682	357	92	64
1974	460	663	292	81	51
1975	332	575	256	69	38
1976	296	482	224	58	33
1977	239	453	199	50	34

1) Based on figures for partial recruitment to the spawning stock.

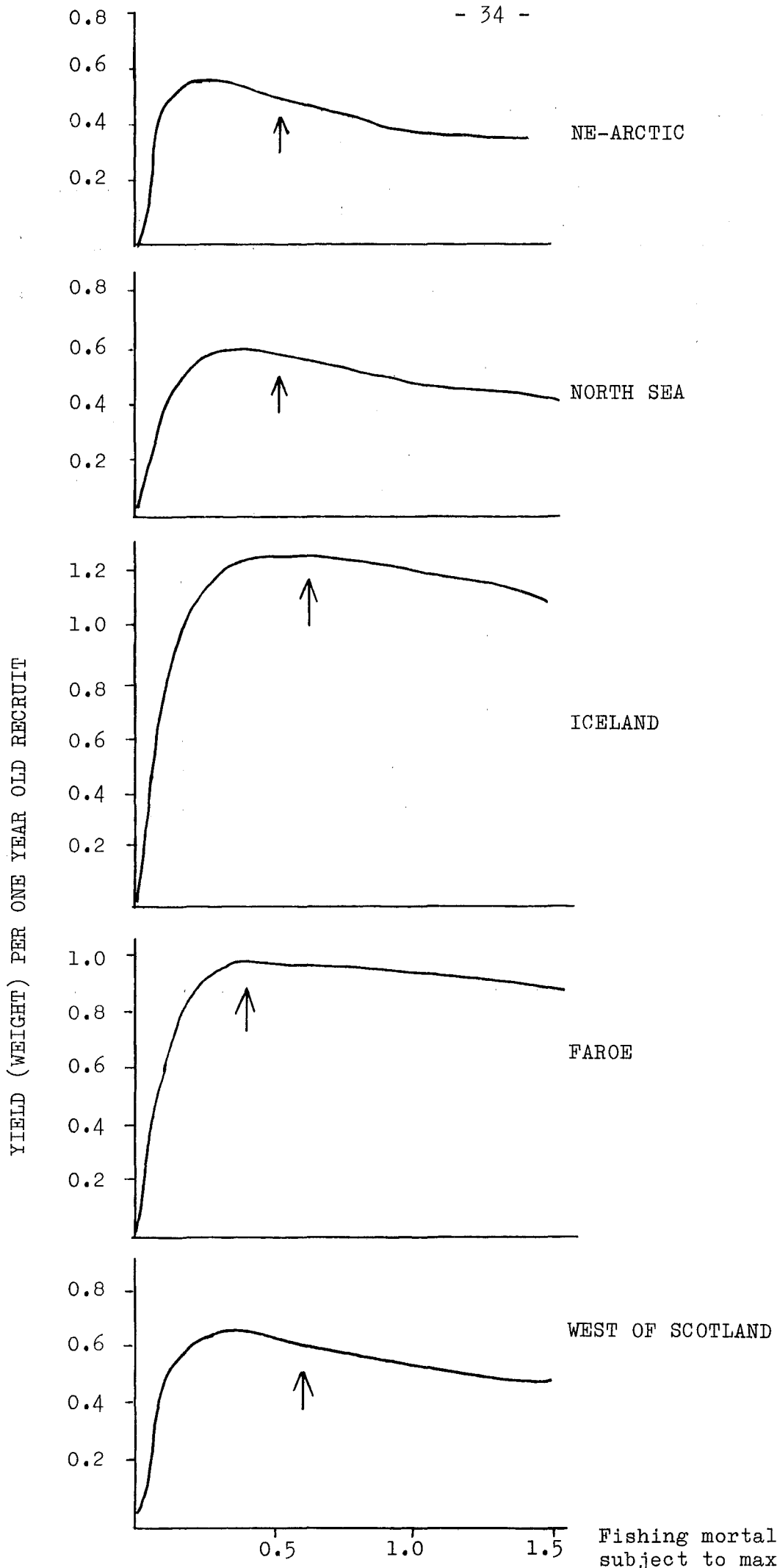


Figure 1. Saithe yield per one year old recruit curves for the present exploitation patterns. Present levels of fishing mortality indicated by arrows.

Fishing mortality on age groups subject to maximum exploitation