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REPORT OF THE WORKING GROUP ON FISH STOCKS AT THE FAROES

Charlottenlund, 7-11 February 1977

REPORT OF THE WORKING GROUP ON FISH STOCKS AT THE FAROES

Contents

APPENDIX: Review of fish resources in the NEAFC Convention Area
presented as a separate document (C.M.1977/F:2 - APPENDIX)

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1. Participation

D.W. Armstrong	U.K. (Scotland)
K. Hoydal (Chairman)	Denmark (Faroe Islands)
T. Jakobsen	Norway
B.W. Jones	U.K. (England)
K. Kosswig	Germany, Fed.Rep.of
J. Lamolet	France
C.T. Macer	U.K. (England)

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

2. Terms of Reference

At the 64th Statutory Meeting of ICES it was decided (C.Res.1976/2:26) that:

"the Working Group on Fish Stocks at the Faroes should meet
in Charlottenlund from 7 to 11 February 1977 to:

(a) assess TACs for 1978 for cod and haddock;

(b) assess the effective mesh size in current use, and
to estimate the effects of further increases in
mesh size for these species;

(c) plan and discuss the design of the International
0-Group Survey at the Faroes in 1977".

Although it was not part of the terms of reference, the Working Group also
reviewed recent data of age and length compositions for ling, blue ling,
tusk and redfish.

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 history, fishery, and
distribution of the stocks in relation to zones under national fisheries
jurisdiction for the following stocks:

Species	Fishing areas
Cod, haddock, whiting	Division Vb
Ling, blue ling, tusk (cusk)	Sub-Areas V and XIV

In agreement with the Chairmen of the North Sea Roundfish and North-East
Arctic Fisheries Working Groups, the description of ling, blue ling and
tusk had been extended to include the total NEAFC area.

3. The State of the Stocks

3.1. Cod (Plateau stock)

An assessment has been made only for the Faroe Plateau cod stock as the
data for Faroe Bank are not sufficiently good for a separate assessment
to be made for that stock.

Cod catch estimates have been updated. Catches from the Faroe Plateau
increased from 24 595 tons in 1974 to 36 103 tons in 1975 with a further
increase to 38 328 tons (provisional) in 1976. The higher catches in 1975
and 1976 are believed to be due to increased fishing effort and also to the
recruitment of the strong 1972 and 1973 year classes.

3.1.1. Virtual Population Analysis (VPA)

Provisional estimates of the total numbers landed in each age group in 1976, and revised values for 1975 were available for the Faroese, Scottish and English fisheries (revised English data for 1974 were also included). The age composition of other countries' landings were estimated by raising the combined English and Scottish data.

Age compositions of the total catches used as input data for the VPA are given in Table 13 (data for 1967-76 only are shown). The data for 1974 and 1975 have been updated and new provisional data are available for 1976. Values of fishing mortality coefficients calculated by VPA are given in Table 14 together with the values assumed for 1976 which were used to initiate the computation.

It is not possible to estimate the current (1976) levels of fishing mortality with any certainty. The values used in the present VPA are the same as those used for the prognosis for 1976 catches made at the 1976 meeting of the Working Group. The estimates of stock size for the last ten years as calculated by VPA are given in Table 15.

3.1.2. Present state of the stock and Total Allowable Catches (TACs)

Last year's prognosis indicated a catch of 38 150 tons from Faroe Plateau for a fishing mortality rate on fully exploited age groups of F = 0.65, which the Group considered would be the likely level of fishing mortality in 1976. According to provisional data, the actual landings in 1976 were 38 328 tons which was in very close agreement with the prediction.

The F at age array assumed for 1976 gives estimated strengths of the 1972 and 1973 year classes as 27.2 and 26.5 million fish at 2 years old (Table 19). These values can be compared with the long-term (1957-71) average year-class strength of 14.8 million. To obtain independent estimates of the strengths of these year classes, the relationship between VPA year-class strength estimates and the English catch-per-unit effort of 2-year-old fish was examined. This relationship has a correlation coefficient of $r = 0.80$ for year classes 1955-71. The graph gave estimates of year-class strengths of 18, 15, and 11 million respectively for 1972, 1973, and 1974 year classes. To obtain similar estimates for the 1972 and 1973 year classes from VPA analysis would require the assumption of values of $F=1.0$ on 3- and 4-year-old fish in 1976. From what is known about the recent development of the fishery such high mortality rates on the younger fish appear unrealistic and the members of the Group preferred the interpretation that these two year classes were particularly abundant ones. The possibility remains that the VPA estimates of 27 million adopted by the Group may prove to be overestimates.

The present level of fishing mortality (F = 0.65) is above that required for maximum sustainable yield F = 0.35 (see Figure 1) with the current exploitation pattern. The fishery is at present regulated under the terms of "Arrangement relating to Fisheries in Waters Surrounding the Faroes" which aimed to limit the combined cod and haddock catch to 52 000 tons. With the recent increase in fishing, this catch has been exceeded in both 1975 and 1976. At F = 0.65 the yield per recruit will be only about 6% below that at F = 0.35 but if the current higher levels of fishing mortality are maintained catch rates in the long term would be expected to be only half those which would be obtained if F was stabilised at 0.35. The spawning stock biomass per recruit will also be depressed at the higher levels of fishing mortality (Figure 2). The Working Group considers that fishing mortality should be reduced as soon as possible to F = 0.35 or to F = 0.18 if it is desired to regulate at the $F_{0.1}$ level.

Although notice has been given to terminate the "Arrangement", no change from the present regulations has yet been proposed for 1977; it was therefore assumed that fishing mortality in 1977 would remain at the 1976 level. On this basis the predicted catch for 1977 is 36 000 tons. For subsequent years it is recommended that fishing mortality should be reduced. To avoid a severe reduction in catch it is proposed that there should be a progressive reduction in F according to the following pattern:

Year	1978	1979	1980
Fishing mortality	0.55	0.45	0.35

Catch prognoses for 1978 and 1979 have been prepared on this basis. Additional data used in the prognoses are given in Table 20.

The prognoses for cod refer only to the Plateau stock and 2 000 tons for catches on Faroe Bank has to be added to give the total Faroe TAC.

The Working Group, therefore, recommends that there should be a progressive reduction in fishing mortality on cod to $F_{MSY} = 0.35$. To achieve such a reduction in fishing mortality, the following TACs are proposed:

Recommended TACs for cod (including Faroe Bank)

Year	F	TAC
1978	0.55	30 000 tons
1979	0.45	25 000 tons (subject to revision)

Should the 1972 and 1973 year classes prove to be less abundant than the estimates used in the prognoses, the TACs recommended for 1978 and 1979 would have to be reduced.

3.1.3. Spawning stock biomass
Figure 3 shows the trend in estimated spawning stock biomass of Plateau cod since 1960. The low levels in the early 1960's were the result of high exploitation levels in 1960-61. Figure 2 shows the dependence of spawning stock biomass per recruit on fishing mortality. If the fishery was to be prosecuted with the present exploitation pattern at a mortality rate on the fully exploited age groups of $F = 0.35$, the equilibrium spawning stock biomass would be expected to be 90 000 tons.

3.2. Haddock

3.2.1. Trends in catch and effort

Haddock catch estimates have been updated and provisional figures for 1976 show a further increase in total landings from 20 694 tons in 1975 to 24 679 tons (provisional) in 1976. This increase is the result of increase in the effort of Faroese longliners and the recruitment of the strong 1972 year class to the fishery.

3.2.2. Virtual Population Analysis (VPA)

3.2.2.1. Data - Provisional estimates of the total numbers landed in each age group in 1976 and revised values for 1975 were available for the Faroese, Scottish and English fisheries. The age composition of the landings by other countries were estimated by raising the combined Scottish and English data (Table 16).

3.2.2.2. Choice of exploitation pattern and F on fully exploited age groups - The exploitation pattern chosen by the Group in 1976 was such that the values of F used gave very high values for the strengths of the 1973 and 1974 year classes. As a result of comments on this point by the Liaison Committee, this exploitation pattern was altered. This still resulted in high estimates of the strengths of the 1973 and 1974 year classes, but the reduced values obtained were thought to be more realistic.

In the current Working Group, the exploitation pattern was further modified as a result of the following consideration.

Trial runs were made with VPA using the most up-to-date data. These indicated that F on the older age groups is probably lower than the value of 1.0 which was previously used. A value of F = 0.6 was assumed for the fully exploited age groups in 1976. To obtain some indication of likely 1976 values of F on the younger age groups, the Group examined data which gave independent estimates of year-class strength. In the 0-group surveys the 1972 brood of haddock appeared as very strong, but the 1973 year class was less abundant. Scottish research vessel data and English commercial catch-per-unit-effort data both indicated that the 1973 and 1974 year classes were of above-average strength (Figure 4). The assumed F values used in the VPA for these year classes were those which generated year-class strengths of about the size indicated from these independent sources. Table 16 gives VPA input data of catches at each age. Calculated fishing mortalities from VPA for 1967-75 and assumed values for 1976 are given in Table 17. Stock size estimates are given in Table 18.

3.3. Current state of the stock and total allowable catches (TACs)

In considering the strategy to be adopted in deciding the TAC for 1978, the Group assumed for the same reasons outlined in the section dealing with cod, that F on the fully exploited age groups in 1977 will be 0.6, i.e. equal to the corresponding value for 1976. On this basis, the predicted yield from the fishery in 1977 is expected to be about 21 000 tons.

The yield per recruit curve shown in Figure 1 was calculated using the exploitation pattern for 1976 and the values of mean weight at age as shown in Table 20. This curve has a maximum at a value of F on the fully exploited age groups of 0.4. Consequently, the Group decided to propose a reduction in the level of F to 0.5 in 1978 followed by a further reduction to 0.4 in 1979. The Working Group therefore recommends the following TACs for the whole of Division Vb.

Year	F		TAC
1978	0.5	=	17 000 tons
1979	0.4	=	14 000 tons (subject to revision)

These TACs are contingent on the assumption that recruitment at age 1 in 1977, 1978 and 1979 will be about 40 million fish and that there will be no further change in the exploitation pattern. The equilibrium yield for F = 0.4 is about 21 000 tons. If it is desired to regulate at the $F_{0.1}$ level, fishing mortality would have to be reduced to F = 0.22.

3.2.4. Spawning stock biomass

The estimated biomass of the spawning stock (age 3 and older) is shown in Figure 3 together with predicted levels in 1977, 1978 and 1979. The spawning stock has tended to decline since 1957, although considerable year to year variations are in evidence. The adoption of the strategy proposed by the Group should result in a spawning stock of about 52 000 tons in 1979. The equilibrium spawning stock biomass should be about 70 000 tons.

4. Mesh Assessments

4.1. Methods

Hoydal (1977) describes a method evolved by Mr K.P. Andersen of the Danish
Fisheries Institute to estimate the effective mesh size employed by various
fishing fleets simultaneously exploiting the same stock. The method also allows
for prediction of the short- and long-term effects of changes in mesh size of
each fleet.

The method as used by the Group had three stages.

1) A check was made on the current level of F and M on the fully exploited age
   groups of cod and haddock. To do this, the values of F and M on the fully
   exploited age groups in 1976, as used in this year's VPA, were used to
   operate on length frequency data over the length range which represents the
   fully exploited age groups. By applying Andersen's method, estimates were
   obtained of the von Bertalanffy parameters K and L_∞ . These estimates
   were then compared with corresponding independently obtained estimates.

   For both species the input values of F and M proved to be acceptable in
   the sense that they produced values of L_∞ and K similar to values
   obtained by direct age determinations (Hoydal, 1976).

2) The accepted values of F were then partitioned between fleets on the basis
   of the numerical catch of each fleet in recent years. These values of F
   were used as input data, and were treated as constants. Von Bertalanffy
   parameters (K, L_∞ , and t_0) were also required as input and were also treated
   as constants. Trial and error runs were then made in which various sets of
   selection curves (defined by their 50% and 75% retention points) were input
   for each fishery. The output from each run is a simulated set of length
   frequency distributions corresponding to each set of selection curves. The
   set of selection curves which produced simulated length frequency distribution
   most similar to those observed was assumed to be the one appropriate to a
   particular fishery.

3) Computation of long- and short-term effects of changes in mesh size was then
   carried out using a method which is essentially the same as that of Gulland
   (1961).

4.2. Results of the second stage of the analysis

4.2.1. Cod

Estimates of selection curve parameters were carried out for five fleets
(Faroese trawlers, Faroese longliners, Faroese gillnetters, Faroese handliners
and total U.K. trawlers). Parameters giving the best fit are shown in Table 22,
while the corresponding simulated and observed length frequency distributions
are shown in Figure 5.

In general, the simulated and observed length frequency distributions are in
good agreement. For the Faroese trawl fishing for haddock, however, a rather
poor fit was obtained, the possible effects of which will be discussed later
(section 4.4.).

4.2.2. Haddock

Estimates were made of the selection curve parameters for four fleets (Faroese
trawlers, Faroese longliners, Scottish trawlers and English trawlers).

The set of parameters producing the best fit is shown in Table 21 and the
corresponding simulated and observed length frequency distributions are shown
in Figure 6.

4.3. Effective mesh size

To correct the 50% selective lengths to mesh size equivalents it is necessary to multiply by an appropriate selection factor.

4.3.1. Cod

For cod, the Group in its 1974 meeting adopted a value of the selection factor of 3.4 (manila). This is equivalent to 3.68 for the synthetic materials currently in use at Faroe. Using this value, the effective mesh sizes in the trawler component of the Faroe cod fishery are:

Faroe trawl	107mm
U.K. trawl	76mm

4.3.2. Haddock

For haddock, the Group adopted a value of 3.1 for the selection factor since, by doing this, good agreement is obtained between the effective mesh size in both the haddock and the cod fisheries. (While the value of 3.1 is, perhaps, a little low, the Group considered that it is not unacceptable.)

The estimated values of effective mesh size in the trawler fleets exploiting haddock are thus:

Faroese trawl	107mm
Scottish trawl	70mm
English trawl	84mm

4.4. Estimated effects of changes in mesh size

The effects of changing the effective mesh size to 120, 135 and 155mm respectively were estimated for both cod and haddock. The results are shown in Tables 22 and 23.

In considering these results, a number of factors must be borne in mind. Firstly, the Group used only data from the years 1974 and 1975, since following the change of legal mesh size in January 1974, it was thought that the average over a longer time period would not accurately reflect the correct situation in the fisheries for cod and haddock. Secondly, the failure to obtain a good fit in the case of the haddock fishery by Faroese trawlers almost certainly gave rise to an over-estimate of the effective mesh size for that fleet. This would give rise to underestimates of initial losses by Faroese trawlers. Although this in turn would affect the whole of the subsequent prognosis, such effects are probably not too serious since the Faroese haddock fishery accounts for less than 10% of the total yield.

5. Other Species

5.1. Ling, blue ling and tusk

In 1976 Norway collected data on ling, blue ling and tusk from the long-line fisheries at Faroe. Age readings by otoliths have been attempted. The age readings are preliminary and can probably be improved by better methods and more experience. However, the resulting age/length relationships seem reasonable and are believed to give a good indication of the age structure and growth rate for all three species. The material is comprised of four samples of about 100 fish. The age compositions are given in Table 24 together with the observed length range of each year class.

5.2. Redfish

German data on age and length for redfish (Sebastes mentella and marinus separate) caught in Division Vb were reviewed by the Group. Percentage age distributions of the catches are given in Figures 7 and 8, and catch and effort data are given in Table 25.

6. O-Group Survey at the Faroes 1977

There was a short discussion on this item. The Group was informed that England would not be able to participate in the international O-group survey at the Faroes in 1977. This leaves the task to France and the Faroes.

The English investigations started in 1972. As yet, only the 1972 year class of cod and haddock has been in the fishery for sufficient time for an estimate of their abundance to be available from VPA; thus it is not possible to make any correlation analysis on the data. The problems of pooling data from different research vessels have been discussed in the reports from the O-group surveys (Anon., 1975).

The Group did not have the time or material to make any decision on the question of the design of the O-group survey, e.g. stratification, random versus non-random sampling etc., and it was left to the two participating countries, France and Faroes, to find a solution to this problem for 1977.

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Hoydal, K., 1976. Faroese Investigations of the Greenland Prawn Fisheries, and an Attempt to Estimate Total Mortality on the Oldest Age Groups. ICNAF Res.Doc. 76/XII/168 + Appendix.

Hoydal, K., 1977. A Method of Mesh Assessment Making it Possible to Check Growth Parameters and Estimate Effective Mesh Size in Operation (in press).

Tables 1-12 Catches in ICES Division Vb by country and species 1960-1976.
Metric tons, round fresh.

Table 1. Cod.

Year	Faroe Islands	France	Germany (Fed.Rep.)	Norway	Poland	U.K. England	U.K. Scotland	Others	Total
1960	8 723	-	451	-	-	13 476	16 300	-	39 220
1961	9 521	-	417	168	-	3 891	12 954	-	26 951
1962	6 751	100	301	505	-	5 521	11 052	-	24 230
1963	7 428	720	376	147	-	4 558	10 875	60	24 164
1964	8 888	989	1 162	333	-	5 845	7 791	50	25 058
1965	9 948	1 538	854	419	-	5 470	7 868	180	26 277
1966	7 957	1 120	669	314	-	4 871	7 855	132	22 918
1967	7 835	871	845	650	-	7 996	8 546	63	26 806
1968	13 763	2 519	1 180	686	-	7 096	8 524	-	33 768
1969	15 718	2 557	447	476	-	6 717	12 249	-	38 164
1970	15 245	2 616	225	238	-	3 707	9 790	-	31 821
1971	12 754	1 426	337	881	-	3 485	9 102	-	27 985
1972	12 143	1 462	262	266	-	3 019	6 483	-	23 635
1973	13 276	1 752	305	115	419	5 079	6 756	-	27 702
1974	13 237	551	292	446	320	3 708	8 019	60	26 633
1975	22 986	1 409	458	1 353	432	3 287	8 619	145	38 689
1976[*]	28 345	1 485	222	1 033	496	3 020	5 336	?	39 937

Table 2. Haddock.

Year	Faroe Islands	France	Germany (Fed.Rep.)	Norway	Poland	U.K. England	U.K. Scotland	Others	Total
1960	7 772	-	6	-	-	7 298	10 943	-	26 019
1961	8 454	-	22	-	-	2 765	9 590	-	20 831
1962	7 042	166	18	-	-	3 766	16 159	-	27 151
1963	6 336	792	22	-	-	4 655	15 766	-	27 571
1964	6 952	1 866	32	111	-	3 442	7 087	-	19 490
1965	6 673	1 939	8	119	-	3 385	6 355	-	18 479
1966	6 902	2 717	40	-	-	2 867	6 240	-	18 766
1967	5 246	1 091	30	-	-	2 347	4 656	11	13 381
1968	6 751	2 286	31	-	-	2 445	6 339	-	17 852
1969	11 122	3 314	45	-	-	1 976	6 815	-	23 272
1970	11 791	2 006	6	-	-	1 137	6 421	-	21 361
1971	10 488	790	1	-	-	2 323	5 762	29	19 393
1972	8 314	2 666	25	-	-	1 371	4 109	-	16 485
1973	6 018	3 508	46	-	1 190	2 426	4 788	-	17 976
1974	4 811	1 451	70	5	685	1 617	6 072	52	14 763
1975	8 757	2 277	173	56	544	2 426	6 078	383	20 694
1976[*]	12 343	2 458	21	30	448	2 264	7 112	?	24 679

[*] Preliminary estimates

Table 3. Saithe.

Year	Faroe Islands	France	Germany (Fed.Rep.)	Norway	Poland	U.K. England	U.K. Scotland	Others	Total
1960	685	-	2 583	-	-	6 437	2 140	-	11 845
1961	929	-	2 219	-	-	4 230	2 214	-	9 592
1962	2 494	620	985	-	-	3 724	2 631	-	10 454
1963	2 431	2 207	1 471	-	-	3 178	3 463	-	12 750
1964	1 338	6 458	6 294	+	-	4 329	3 309	-	21 728
1965	1 000	8 565	3 611	-	-	5 265	3 794	-	22 235
1966	1 167	9 967	4 772	2 498	-	3 321	3 581	66	25 372
1967	2 242	5 555	6 119	-	-	3 536	3 996	193	21 641
1968	2 629	424	7 532	-	-	5 123	4 778	-	20 486
1969	4 835	7 899	4 775	378	-	4 303	5 346	-	27 536
1970	2 694	11 036	2 249	1 495	-	3 066	8 608	-	29 148
1971	5 653	10 621	2 251	1 839	-	3 305	7 198	63	30 930
1972	5 646	28 346	3 613	470	-	2 453	6 225	-	46 753
1973	2 973	22 241	9 087	355	4 050	7 527	10 131	-	56 364
1974	3 726	19 428	6 661	1 660	1 925	3 827	8 302	630	46 159
1975	2 517	23 630	5 229	486	815	2 428	4 950	171	41 226
1976*)			2 258			3 033			

Table 4. Whiting.

Year	Faroe Islands	France	Germany (Fed.Rep.)	Norway	Poland	U.K. England	U.K. Scotland	Others	Total
1960	-	-	-	-	-	70	403	-	473
1961	222	1 200	-	-	-	50	257	-	1 729
1962	-	-	-	-	-	26	197	-	223
1963	-	-	+	-	-	33	285	-	318
1964	-	-	+	-	-	25	117	-	142
1965	-	1 421a)	+	-	-	29	97	-	1 547
1966	-	225	-	-	-	28	139	-	392
1967	-	254	1	-	-	31	138	3	427
1968	-	80	1	-	-	46	172	-	299
1969	-	16 991	+	-	-	46	515	-	17 552
1970	-	73	-	-	-	35	251	-	359
1971	150	195	1	-	-	26	166	4	542
1972	-	194	-	-	-	137	139	-	470
1973	384	72	7	-	8	235	394	-	1 100
1974	167	791	3	-	-	89	750	293	2 093
1975	251	1 238	87	-	-	242	973	718	3 509
1976*)	509	1 443	-				1 031		

*) Preliminary estimates.

a) Includes Iceland grounds (Va).

Table 5. Tusk.

Year	Faroe Islands	France	Germany (Fed.Rep.)	Norway	U.K. England	U.K. Scotland	Total
1960	1 306	-	32	734	135	1 260	3 467
1961	1 301	-	29	1 401	67	1 062	3 860
1962	1 902	-	21	1 134	54	1 405	4 516
1963	2 007	-	29	802	28	695	3 561
1964	2 775	-	137	875	30	799	4 616
1965	1 645	-	115	1 565	32	924	4 281
1966	1 488	-	87	1 221	21	482	3 299
1967	2 070	-	109	2 729	18	432	5 358
1968	2 798	-	91	2 906	23	549	6 367
1969	1 454	-	21	1 338	16	412	3 241
1970	1 028	-	19	1 475	11	515	3 048
1971	1 489	-	44	1 872	13	419	3 837
1972	1 918	-	139	2 421	16	386	4 880
1973	3 402	-	134	3 066	36	531	7 169
1974	1 541	-	137	1 841	22	403	3 944
1975	2 166	-	154	1 848	36	344	4 552
1976[*)	2 444	-	23				

[*) Preliminary estimates.

Table 6. Ling.

Year	Faroe Islands	France	German Dem.Rep.	Germany Fed.Rep.	Norway	Poland	U.K. England	U.K. Scotland	Total
1960	520	-	-	895	400	-	629	855	3 299
1961	603	-	-	11	521	-	241	829	2 205
1962	450	387	-	9	326	-	247	572	1 991
1963	365	1 512	-	17	496	-	183	396	2 969
1964	480	2 844	-	48	736	-	322	632	5 062
1965	416	2 618	-	30	832	-	184	388	4 468
1966	416	1 827	-	39	2 115	-	276	496	5 169
1967	736	23	-	60	3 203	-	172	364	4 558
1968	1 209	177	-	68	3 340	-	152	679	5 625
1969	486	195	-	45	1 952	-	225	602	3 505
1970	699	578	-	42	1 737	-	164	883	4 103
1971	752	728	-	46	2 898	-	152	879	5 455
1972	1 572	866	-	74	3 958	-	146	772	7 388
1973	1 428	398	-	167	3 638	11	268	850	6 760
1974	1 004	296	9	131	2 395	4	308	575	4 722
1975	1 281	345	1	94	2 297	2	231	499	4 750
1976*)	1 682			28	3 500				

Table 6a. Blue ling.

Year	Faroe Islands	France	German Dem.Rep.	Germany Fed.Rep.	Norway	Poland	U.K. England	U.K. Scotland	Total
1963	-	-	-	478	-	-	-	-	478
1964	-	-	-	2 493	182	-	-	-	2 675
1965	-	-	-	1 612	1 120	-	-	-	2 732
1966	-	-	-	850	430	-	-	-	1 280
1967	-	-	-	1 133	238	-	-	-	1 371
1968	-	-	-	1 858	788	-	-	-	2 646
1969	-	-	-	249	798	-	-	-	1 047
1970	-	-	-	335	2 612	-	-	-	2 947
1971	-	-	-	1 475	557	-	-	-	2 032
1972	-	-	-	2 779	1 203	-	-	-	3 982
1973	51	-	-	2 931	4 003	-	4	-	6 989
1974	43	-	390	1 808	1 554	-	3	-	3 798
1975	18	-	2 281	1 528	2 492	-	1	-	6 320
1976*)	20	-	6 220	442	1 330	-	-	-	7 992

- Indicates no catch or species not separated.

*) Preliminary estimates.

Table 7. Lemon sole.

Year	Faroe Islands	France	U.K. England	U.K. Scotland	Others	Total
1960	-	-	351	1 026	-	1 377
1961	-	-	156	1 009	-	1 165
1962	-	-	187	910	-	1 097
1963	-	-	142	706	-	848
1964	-	27	112	305	-	444
1965	-	42	110	393	-	545
1966	-	49	99	297	-	445
1967	-	14	104	321	-	439
1968	-	20	84	404	-	508
1969	-	-	77	362	2	441
1970	-	-	68	424	-	492
1971	590	-	76	303	-	969
1972	300	-	35	244	-	579
1973	1 190	-	126	393	-	1 709
1974	607	-	137	503	-	1 247
1975	971	-	103	369	1	1 444
1976*)	791	-	-	-	-	-

Table 8. Plaice.

Year	Faroe Islands	France	U.K. England	U.K. Scotland	Others	Total
1960	64	-	62	209	-	335
1961	83	-	38	194	-	315
1962	26	-	73	164	-	263
1963	4	226	39	130	-	399
1964	11	131	64	99	-	305
1965	6	92	79	143	-	320
1966	1	108	106	161	-	376
1967	7	54	120	172	2	355
1968	102	28	158	170	-	458
1969	192	31	82	181	-	486
1970	288	-	59	205	-	552
1971	143	-	45	173	-	361
1972	130	+	50	111	-	291
1973	139	-	95	134	4	372
1974	89	44	43	115	-	291
1975	178	2	52	143	4	379
1976*)	109	35				

*) Preliminary estimates.

Table 9. Halibut.

Year	Faroe Islands	France	Germany (Fed.Rep.)	Norway	Poland	U.K. England	U.K. Scotland	Total
1960	218	-	58	439	-	686	1 397	2 798
1961	222	-	165	327	-	287	1 237	2 238
1962	137	-	11	299	-	325	1 126	1 898
1963	161	-	10	128	-	241	887	1 427
1964	174	-	63	110	-	239	792	1 378
1965	276	-	35	124	-	292	725	1 452
1966	169	-	36	120	-	248	636	1 209
1967	245	-	57	180	-	178	749	1 409
1968	267	-	64	90	-	130	698	1 249
1969	205	-	18	151	-	124	558	1 056
1970	296	-	10	182	-	74	514	1 076
1971	234	-	14	197	-	92	371	908
1972	212	-	35	155	-	60	256	718
1973	256	-	52	78	5	144	359	894
1974	141	-	54	56	4	105	218	578
1975	162	65	73	75	-	93	207	675
1976[*)	313		16					

Table 10. Megrim.

Year	Faroe Islands	France	Germany (Fed.Rep.)	Norway	Poland	Spain	U.K. England	U.K. Scotland	Total
1960	-	-	-	-	-	-	9	21	30
1961	-	-	-	-	-	-	8	17	25
1962	-	-	-	-	-	-	6	19	25
1963	-	-	-	-	-	-	5	26	31
1964	-	50	-	-	-	-	5	20	75
1965	-	47	-	-	-	-	5	17	69
1966	-	237	-	-	-	-	5	14	256
1967	-	212	-	-	-	-	1	6	219
1968	-	250	-	-	-	-	3	6	259
1969	-	312	1	-	-	-	3	8	324
1970	-	99	-	-	-	-	1	9	109
1971	-	37	-	-	-	-	2	9	48
1972	-	38	-	-	-	-	3	10	51
1973	-	-	-	-	-	-	4	11	15
1974	-	-	-	-	-	10	8	12	30
1975	-	6	-	-	-	14	4	8	32

[*) Preliminary estimates.

Table 11. Redfish.

Year	Faroe Islands	France	German Dem.Rep.	Germany Fed.Rep.	Norway	U.K. England	U.K. Scotland	Total
1960	-	-	-	2 295	-	276	60	2 631
1961	-	-	-	3 577	-	50	38	3 665
1962	-	-	-	2 237	-	52	49	2 338
1963	1	366	-	2 035	-	31	60	2 493
1964	-	705	-	7 119	-	41	43	7 908
1965	1	582	-	4 864	-	38	27	5 512
1966	-	-	-	3 180	-	8	40	3 228
1967	-	-	-	4 853	-	24	22	4 899
1968	1	-	-	6 613	-	43	10	6 667
1969	5	-	-	1 225	-	13	15	1 258
1970	-	-	-	2 020	-	13	20	2 053
1971	-	-	-	2 479	-	12	12	2 503
1972	-	-	-	4 027	-	40	13	4 080
1973	121	-	-	9 439	-	72	13	9 645
1974	28	300	1	7 328	10	74	24	7 765
1975	9	800	1	7 628	7	18	23	8 486
1976*)	33			3 459				

Table 12. Angler (Monk).

Year	Faroe Islands	France	Germany (Fed.Rep.)	U.K. England	U.K. Scotland	Others	Total
1960	-	-	7	314	811	-	1 132
1961	-	-	11	167	695	-	873
1962	-	-	4	179	641	-	824
1963	-	-	2	160	618	-	780
1964	-	-	3	218	347	-	568
1965	-	-	-	212	326	-	538
1966	-	-	-	164	349	-	513
1967	-	-	-	118	308	-	426
1968	-	-	3	159	335	-	497
1969	1	26	1	175	429	-	632
1970	-	10	-	127	542	-	679
1971	-	-	-	132	532	-	664
1972	-	-	3	99	388	-	490
1973	535	-	6	193	414	-	1 148
1974	418	-	22	167	413	40	1 060
1975	456	19	7	125	347	90	1 044
1976*)	501	-	3	-	-	-	

*) Preliminary estimates.

Table 13. Cod (Faroe Plateau). Total numbers of fish caught at each age x 10^{-3}

Age/Year	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976
1	127	34	68	35	78	44	211	284	92	16
2	1 609	1 529	878	402	328	875	719	2 460	3 248	1 521
3	2 690	3 322	3 106	1 163	757	1 176	3 111	1 538	4 600	5 879
4	860	2 663	3 300	2 172	821	810	1 586	2 036	1 821	4 212
5	1 706	945	1 538	1 685	1 287	596	705	1 035	2 318	1 200
6	847	1 226	477	752	1 451	1 021	384	477	790	824
7	309	452	713	244	510	596	312	250	233	314
8	64	105	203	300	114	154	227	207	174	98
9	27	11	92	44	179	25	121	125	92	69

Table 14. Cod (Faroe Plateau). Estimates of fishing mortality 1967-75 and assumed values for 1976. Natural mortality $M = 0.2$

Age/Year	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976
1	0.01	0.00	0.01	0.00	0.00	0.00	0.01	0.01	0.01	0.00
2	0.08	0.10	0.13	0.07	0.04	0.06	0.07	0.10	0.14	0.18
3	0.25	0.24	0.31	0.25	0.17	0.17	0.30	0.22	0.29	0.42
4	0.27	0.41	0.39	0.38	0.28	0.29	0.36	0.32	0.44	0.47
5	0.35	0.55	0.44	0.36	0.41	0.34	0.43	0.43	0.74	0.59
6	0.59	0.45	0.60	0.40	0.60	0.66	0.38	0.59	0.69	0.65
7	0.50	0.74	0.52	0.71	0.53	0.53	0.43	0.46	0.66	0.65
8	1.05	0.31	0.91	0.43	0.90	0.30	0.40	0.58	0.69	0.65
9	0.50	0.50	0.50	0.50	0.50	0.50	0.40	0.40	0.55	0.65

Table 15. Cod (Faroe Plateau). Estimates of stock size (numbers x 10^{-3})

Age/Year	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976
1	21 020	9 826	8 367	12 827	21 169	13 716	33 483	32 700	12 507	19 623
2	22 807	17 095	8 014	6 789	10 470	17 262	11 190	27 223	26 516	10 157
3	13 572	17 221	12 617	5 770	5 195	8 276	13 343	8 513	20 070	18 782
4	3 934	8 692	11 110	7 539	3 678	3 572	5 717	8 128	5 586	12 297
5	6 382	2 447	4 727	6 135	4 223	2 273	2 196	3 256	4 825	2 942
6	2 079	3 693	1 158	2 491	3 510	2 302	1 326	1 166	1 738	1 882
7	861	945	1 924	521	1 364	1 576	973	741	528	717
8	107	428	370	937	209	660	756	517	382	224
9	75	31	256	122	498	70	402	416	238	158

Table 16. Faroe Haddock. Total numbers of fish caught at each age x 10^{-3}

Age/Year	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976
1	69.6	48.8	94.7	56.7	55.1	42.7	663	253	94	40
2	1 424.9	5 881.4	2 383.8	1 728.2	717.4	750	3 039	7 446	7 493	4 515
3	2 405.1	4 096.8	7 539.1	4 855.4	4 392.7	3 744.1	7 944	2 562	8 060	7 854
4	2 598.8	2 812	4 567	6 580.8	4 727	4 179.3	1 175	3 324	2 056	6 537
5	1 784.9	1 524.3	1 564.8	1 624.1	3 267.4	2 706.4	2 635	400	1 363	1 191
6	1 426.2	1 525.8	1 484.9	1 383	1 292.2	1 170.6	871	799	237	1 118
7	630.5	922.6	1 223.9	1 098.5	863.5	695.7	969	489	347	290
8	197.2	230.2	377.9	325.7	222.3	179.6	139	534	234	657
9	51.8	68.1	113.9	68	146.7	113.1	66	67	399	245

Table 17. Faroe Haddock. Estimates of fishing mortality 1967-75 and assumed values for 1976. Natural mortality M = 0.2

Age/Year	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976
1	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.00	0.00
2	0.07	0.15	0.09	0.07	0.07	0.03	0.24	0.21	0.23	0.20
3	0.20	0.28	0.30	0.28	0.25	0.67	0.56	0.34	0.38	0.40
4	0.31	0.37	0.57	0.47	0.49	0.41	0.46	0.48	0.49	0.60
5	0.31	0.30	0.36	0.41	0.45	0.58	0.49	0.28	0.37	0.60
6	0.56	0.48	0.53	0.63	0.68	0.28	0.37	0.27	0.27	0.60
7	0.73	0.89	0.93	0.99	1.09	1.02	0.40	0.37	0.18	0.60
8	0.84	0.65	1.25	0.69	0.55	0.69	0.57	0.40	0.30	0.60
9	0.80	0.80	0.80	0.80	0.80	0.60	0.60	0.60	0.60	0.60

Table 18. Faroe Haddock. Estimates of stock size (numbers x 10^{-3})

Age/Year	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976
1	55 601	35 581	34 498	13 484	31 340	18 837	52 755	49 291	33 558	29 444
2	24 107	45 460	29 087	28 159	10 988	25 610	15 384	42 593	40 128	27 390
3	14 870	18 451	31 920	21 664	21 495	8 349	20 290	9 861	28 170	26 111
4	10 778	10 009	11 423	19 357	13 372	13 647	3 491	9 502	5 772	15 828
5	7 276	6 489	5 670	5 266	9 950	6 712	7 424	1 805	4 801	2 884
6	3 639	4 353	3 942	3 237	2 854	5 216	3 074	3 717	1 118	2 707
7	1 330	1 703	2 197	1 898	1 414	1 183	3 218	1 735	2 325	702
8	379	526	573	710	578	391	350	1 765	981	1 591
9	102	135	225	134	290	274	160	162	966	593

Table 19. Faroe Plateau Cod and Faroe Haddock.
Estimates of year-class strength as millions of 2-year-old fish
from VPA. Natural mortality M = 0.2.

Year class	Cod	Haddock
1955	-	34.7
1956	-	38.8
1957	13.1	42.8
1958	14.1	35.2
1959	11.9	50.5
1960	20.6	38.0
1961	20.0	46.7
1962	21.6	29.4
1963	8.1	22.0
1964	18.1	19.4
1965	22.8	24.1
1966	17.1	45.5
1967	8.0	29.1
1968	6.8	28.2
1969	10.5	11.0
1970	17.3	25.6
1971	11.2	15.4
1972	(27.2)	(42.6)
1973	(26.5)	(40.1)
1974	(10.2)	(27.4)

Table 20. Input data for the prognosis.

Cod. ICES Sub-Division Vb$_1$ Haddock. ICES Division Vb

Age	Average weight (kg)	Relative F[*])	Catch 1976 x 10⁻³	Average weight (kg)	Relative F[*])	Catch 1976 x 10⁻³
1	.46	0.02	16	0.3	.0025	40
2	1.06	0.27	1 521	0.47	.33	4 515
3	1.89	0.64	5 879	0.73	.66	7 854
4	2.92	0.73	4 212	1.13	1	6 537
5	4.07	0.91	1 200	1.55	1	1 191
6	5.30	1	824	1.97	1	1 118
7	6.58	1	314	2.41	1	290
8	7.85	1	98	2.76	1	657
9	9.08	1	69	3.07	1	245
10+	10.27	1	81	3.55+	1	305

[*])Proportion of F relative to F on age groups subject to maximum exploitation.

Recruitment (at age 1)

Recruitment of 19 500 assumed for year classes after 1975.

Recruitment of 40 000 assumed for year classes after 1975.

Table 21. Best fit selectivity parameters from the Andersen mesh assessment.

1) Cod. M = 0.2 SF = 3.68 (Synthetic).

	F	Selectivity			
		Ascending limb		Descending limb	
		50%	75%	50%	75%
Faroe Trawl	0.094	39.2cm	44.2cm	101.0cm	95.0cm
Longline	0.140	70.0	80.0		
Gillnet	0.176	79.0	87.0	105.0	95.0
Handline	0.051	48.5	50.5		
U.K. Trawl	0.187	28.1	33.1		
Recruitment		60.0	70.0		

2) Haddock. M = 0.2 SF = 3.10 (Synthetic).

Faroe Trawl	0.096	33.1cm	35.1cm	50.0	47.0
Longline	0.200	30.0	31.0		
Scotland Trawl	0.280	21.7	22.7	52.0	49.0
England Trawl	0.080	26.0	29.0	53.0	50.0

Table 22. Cod. Mesh assessment gains and losses, %.

Mesh increase from current effective size to 120mm (synthetic)
50% retention length + = < 0.5%

Year	Faroe Trawl	Faroe Longline	Faroe Gillnet	Faroe Handline	UK Trawl	Total
1	+	+	+	+	-1.6	-0.6
2	+	+	+	+	-1.5	-0.5
3	+	+	+	+	-1.2	-0.3
4	+0.7	+	+	.7	-1.0	+
5	+1.0	+0.7	+0.6	+1.0	-0.7	+0.2
10	+1.5	+1.5	+1.5	+1.5	+	+0.8
20	+1.5	+1.6	+1.6	+1.6	+	+0.9

Mesh increase from current effective size to 135mm (synthetic)

Year	Faroe Trawl	Faroe Longline	Faroe Gillnet	Faroe Handline	UK Trawl	Total
1	-5.2	+	+	+	-7.0	-3.8
2	-4.3	+0.7	+	+1.28	-6.1	-3.0
3	-3.0	+1.7	+1.2	+2.6	-4.9	-1.8
4	-1.5	+3.1	+2.5	+4.1	-3.5	-0.5
5	+	+4.5	+4.0	+5.3	-2.3	+0.8
10	+1.5	+7.5	+7.7	+7.3	+	+3.1
20	+1.5	+7.7	+7.8	+7.5	+	+3.2

Mesh increase from current effective size to 155mm (synthetic)

Year	Faroe Trawl	Faroe Longline	Faroe Gillnet	Faroe Handline	UK Trawl	Total
1	-14.8	+0.5	+	+1.0	-15.2	-8.8
2	-12.7	+2.3	+1.63	+3.6	-13.3	-6.9
3	-9.8	+5.0	+4.0	+6.7	-10.6	-4.1
4	-6.9	+8.1	+7.2	+9.6	-7.9	-1.2
5	-4.7	+11.0	+10.7	+11.9	-5.7	+1.2
10	-1.8	+16.4	+17.0	+15.5	-2.3	+5.3
20	-1.7	+16.8	+17.2	+15.8	-2.1	+5.5

Table 23.   Haddock.   Mesh assessment gains and losses, %.

Mesh increase from current effective size to 120mm (synthetic)					
Year	Faroe Trawl	Faroe Longline	Scotland Trawl	England Trawl	Total
1	-24.1	+7.6	-51.6	-43.3	-27.5
2	-5.6	+26.3	-40.7	-30.9	-13.0
3	+17.4	+43.7	-26.4	-14.6	+3.3
4	+31.8	+55.7	-16.7	-2.9	+14.5
5	+36.8	+64.0	-12.6	+2.3	+20.3
10	+38.3	+83.0	-11.0	+4.7	+28.0
20	+38.3	+87.9	-11.0	+4.7	+29.8

Mesh increase from current effective size to 135mm (synthetic)					
1	-55.0	+11.4	-69.7	-63.6	-39.3
2	-40.0	+38.2	-60.4	-52.9	3.2
3	-17.5	+64.0	-45.8	-35.8	-3.7
4	+	+83.2	-33.4	-20.8	-11.8
5	+7.0	+96.7	-27.6	-13.2	+20.6
10	+9.2	+128.2	-25.3	-9.8	+32.1
20	+9.2	+136.1	-25.3	-9.8	+36.0

Mesh increase from current effective size to 155mm (synthetic)					
1	-84.4	+15.0	-87.9	-84.6	-51.2
2	-78.2	+49.9	-83.5	-79.2	-35.8
3	-67.7	+85.6	-75.6	-69.4	-17.8
4	-55.7	+115.5	-66.0	-57.2	-0.6
5	-48.0	+138.6	-59.3	-48.2	+12.2
10	-44.7	+192.7	-55.8	-43.0	+33.6
20	-44.7	+206.0	-55.8	-43.0	+38.2

Table 24. Age composition and age/length relationship for Ling, Blue Ling and Tusk from Norwegian longline catches in Division Vb in 1976.

Age	Ling		Blue Ling		Tusk		Tusk	
	Faroe Bank		Faroe Bank		Faroe Bank		Lousy Bank	
	%	Length range (cm)	%	Length range[*] (cm)	%	Length range (cm)	%	Length range (cm)
8	13.9	66-87	-	-	2.0	37-40	-	-
9	18.8	61-98	-	-	1.0	42	-	-
10	15.8	75-101	-	-	2.0	46	1.0	43
11	8.9	81-105	-	-	1.0	46	-	-
12	16.8	79-109	-	-	6.0	42-54	-	-
13	4.0	81-96	-	-	5.0	52-60	2.0	44-45
14	7.9	80-115	-	-	2.0	55-56	7.0	49-55
15	6.9	82-132	4.5	71-86	5.0	56-62	6.0	59-62
16	3.0	111-134	7.5	81-110	4.0	58-63	13.0	51-65
17	3.0	109-124	7.5	83-105	8.0	58-64	18.0	55-67
18	-	-	9.0	73-112	6.0	58-66	13.0	56-67
19	1.0	123	10.5	83-117	9.0	61-68	7.0	60-68
20	-	-	6.7	88-120	5.0	64-69	4.0	55-70
21	-	-	9.0	81-122	14.0	61-70	5.0	58-68
22	-	-	1.5	108	8.0	63-68	1.0	67
23	-	-	6.7	88-127	5.0	65-69	1.0	55
24	-	-	11.2	105-137	5.0	67-73	11.0	67-74
25	-	-	6.0	122-137	5.0	67-71	3.0	70-73
26	-	-	7.5	108-142	1.0	70	2.0	70-71
27	-	-	4.5	127-137	2.0	72-74	2.0	71-73
28	-	-	4.5	122-137	2.0	72-74	2.0	76-77
29	-	-	0.7	132	1.0	70	1.0	75
30	-	-	1.5	98-125	1.0	74	1.0	76
31	-	-	1.5	122-149	-	-	-	-
N	101		134		100		100	

[*] Converted from head length to total length.

Table 25. Blue Ling and Redfish catches off Faroe Islands 1963-76 and total
effort from the Federal Republic of Germany's catch per fishing day.

Year	FRG catch (tons)		FRG catch (tons) per fishing day		Total catch by all countries (tons)		Total effort for all countries	
	Blue Ling	Redfish	Blue Ling	Redfish	Blue Ling	Redfish	Blue Ling	Redfish
1963	478	2 035	1.0	4.1	478	2 493	-	608
1964	2 493	7 119	1.5	4.3	2 675	7 908	1 783	1 839
1965	1 612	4 864	1.2	3.5	2 732	5 512	2 277	1 575
1966	850	3 180	0.7	2.7	1 280	3 228	1 829	1 196
1967	1 133	4 853	0.8	3.3	1 371	4 899	1 714	1 485
1968	1 858	6 613	1.0	3.5	2 646	6 667	2 646	1 905
1969	249	1 225	0.4	1.8	1 047	1 258	2 618	699
1970	335	2 020	0.6	3.7	2 947	2 053	4 912	555
1971	1 475	2 479	1.9	3.1	2 032	2 503	1 069	807
1972	2 779	4 027	2.2	3.2	3 982	4 080	1 810	1 275
1973	2 931	9 439	1.5	4.8	6 989	9 645	4 659	2 009
1974	1 808	7 328	1.1	4.4	3 408	7 765	3 098	1 765
1975	1 528	7 639	0.97	4.8	4 039	7 791	4 164	1 623
1976[*]	442	3 459	1.0	4.6	-	-	-	-

[*] Preliminary estimates.
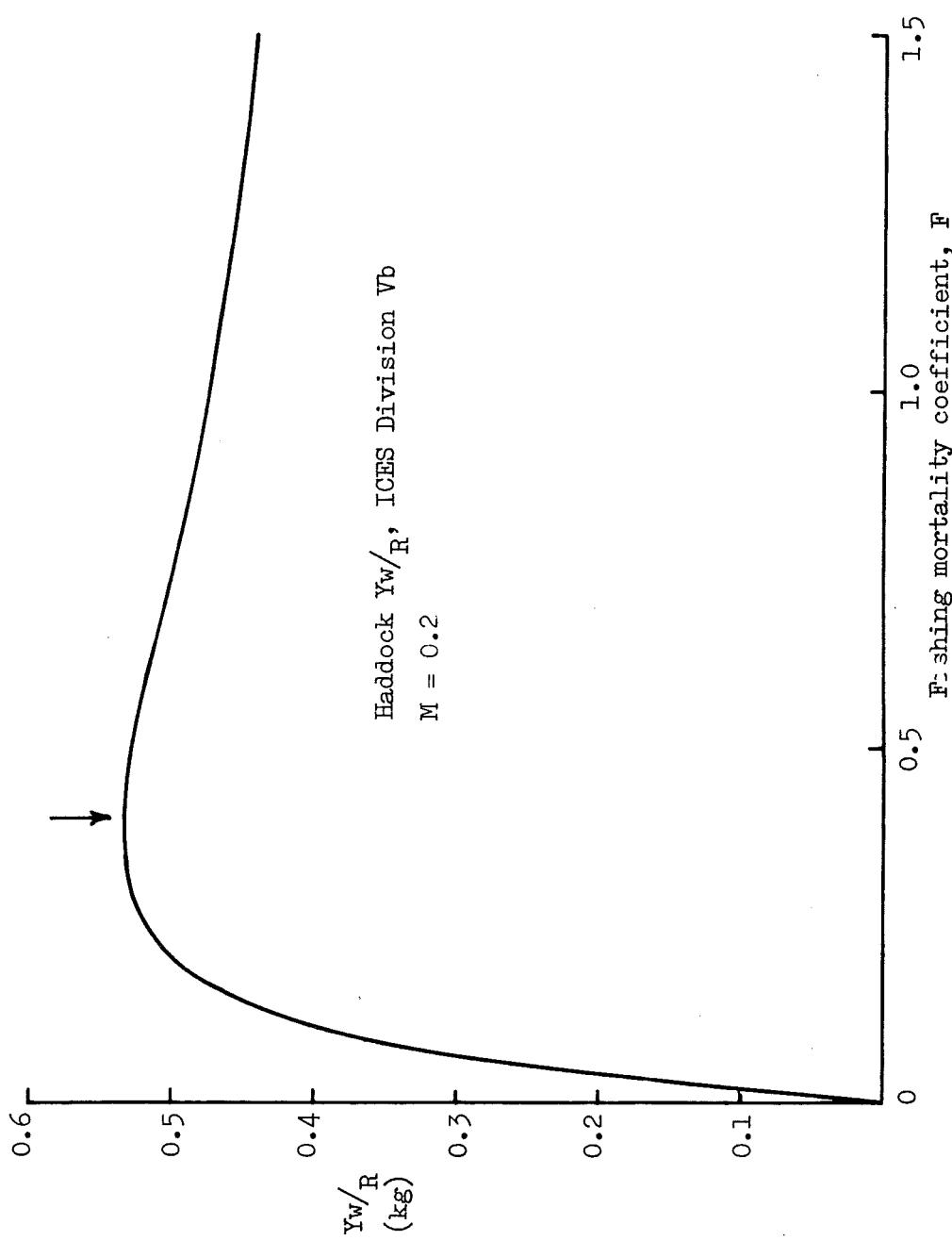
Figure 1. Yield per recruit curves.

Faroe Plateau Cod, $Y_w/_R$, ICES Sub-
division Vb_1

$M = 0.2$

Fishing mortality coefficient, F

$Y_w/_R$
kg
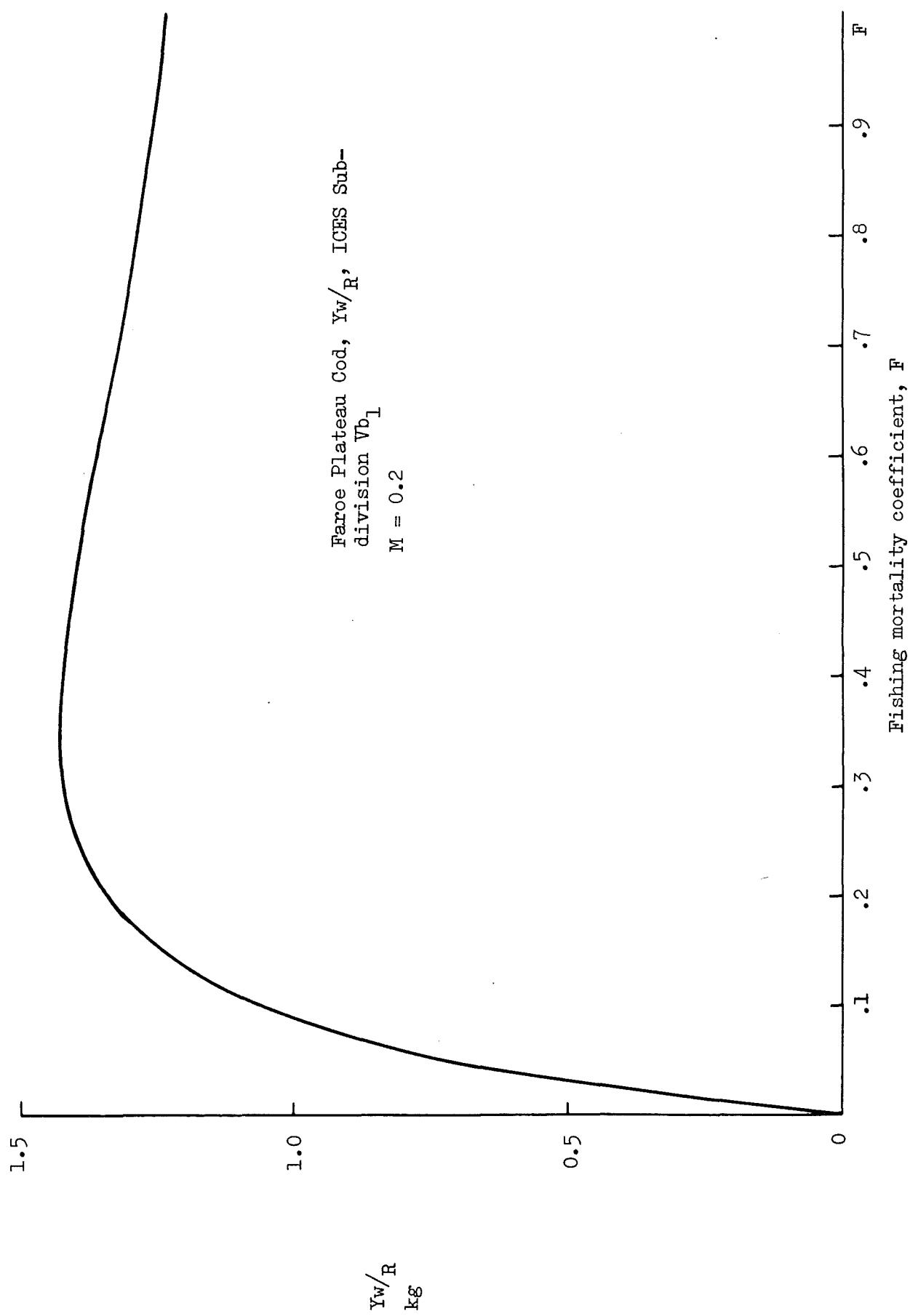
Figure 1 (Continued)
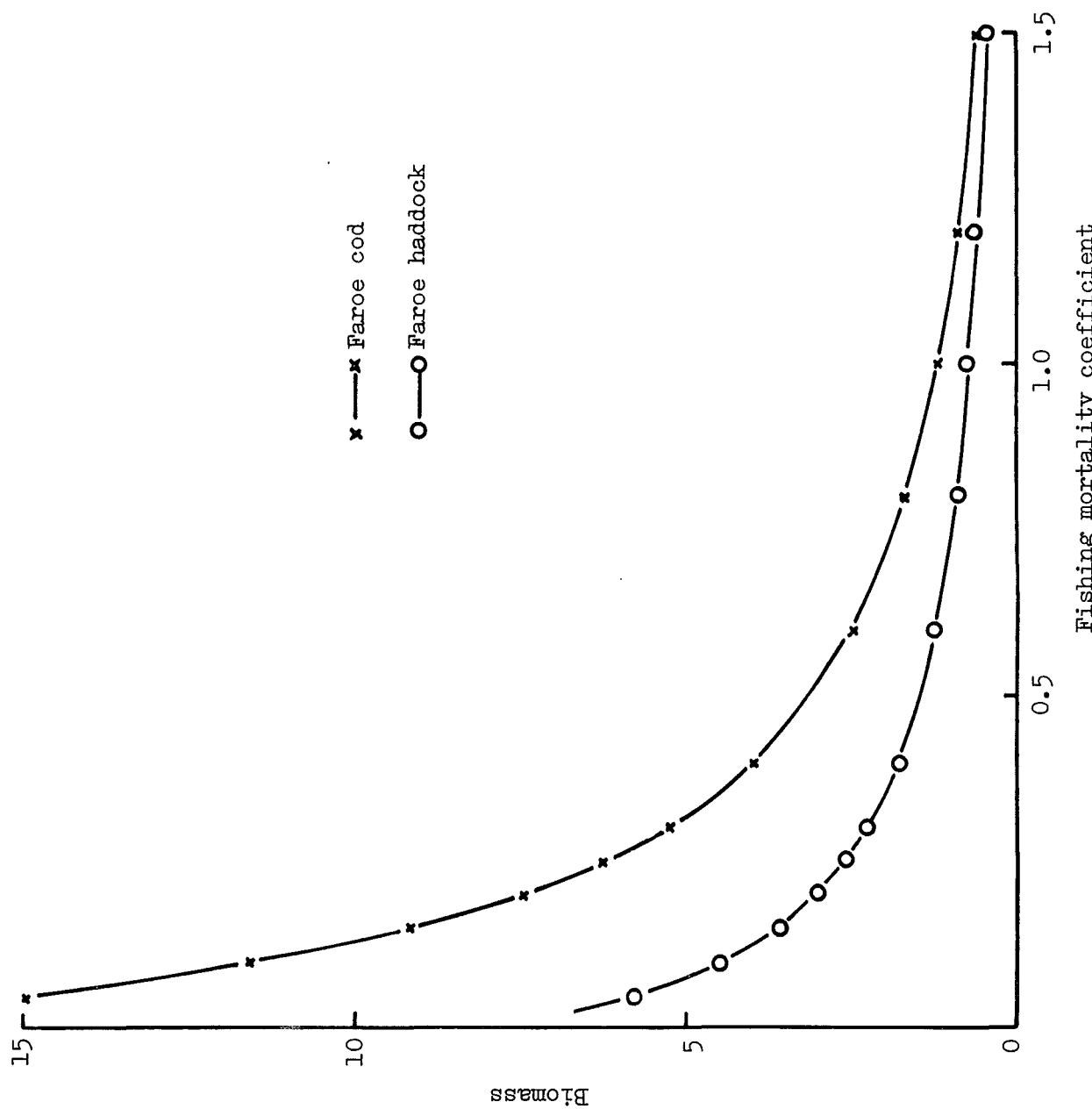
Figure 2. Spawning stock biomass per recruit related to fishing mortality rate M=0.2.

Figure 3. Spawning stock biomass.
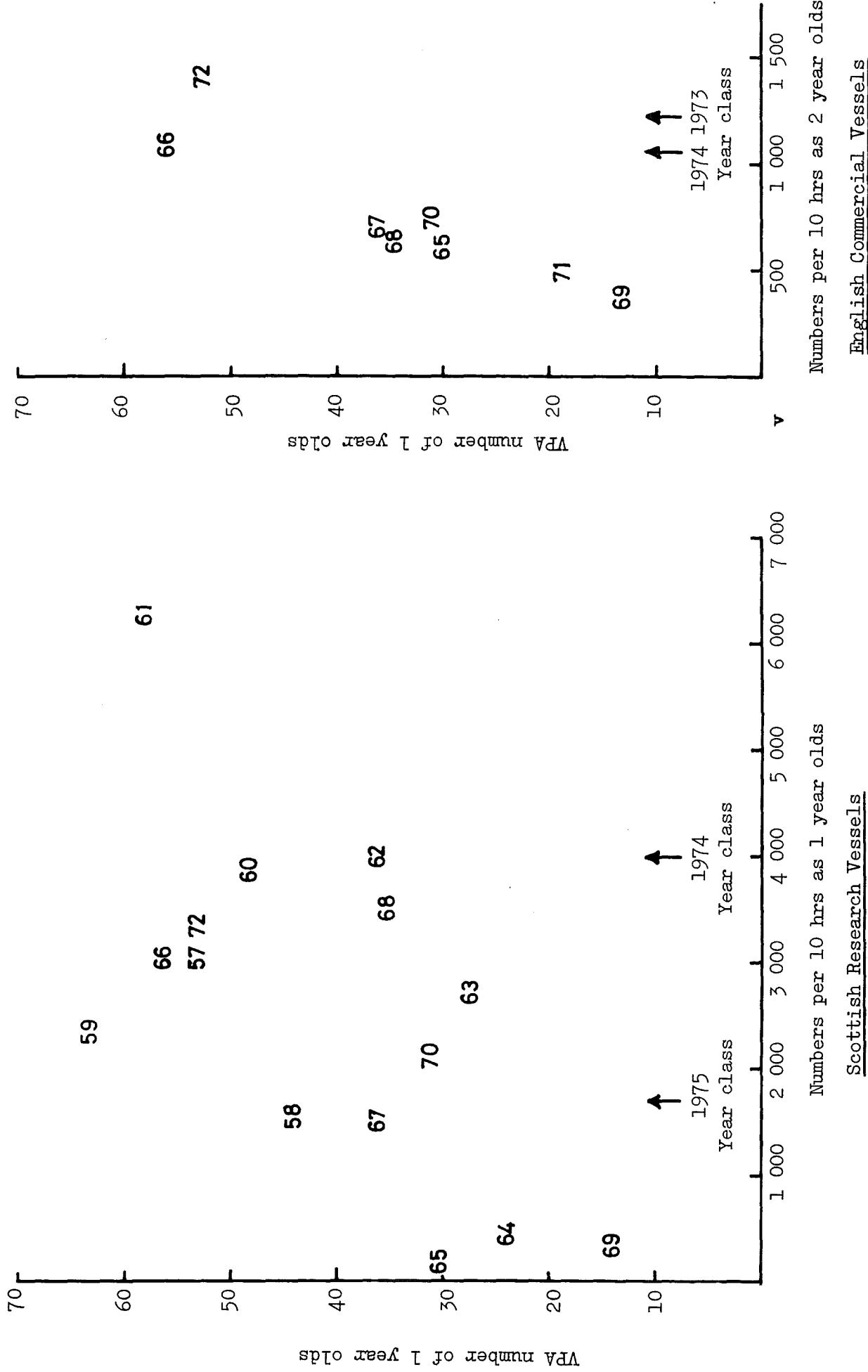
Figure 4. Haddock. Estimated recruitment from VPA vs. Catch per 10 hrs by year class.
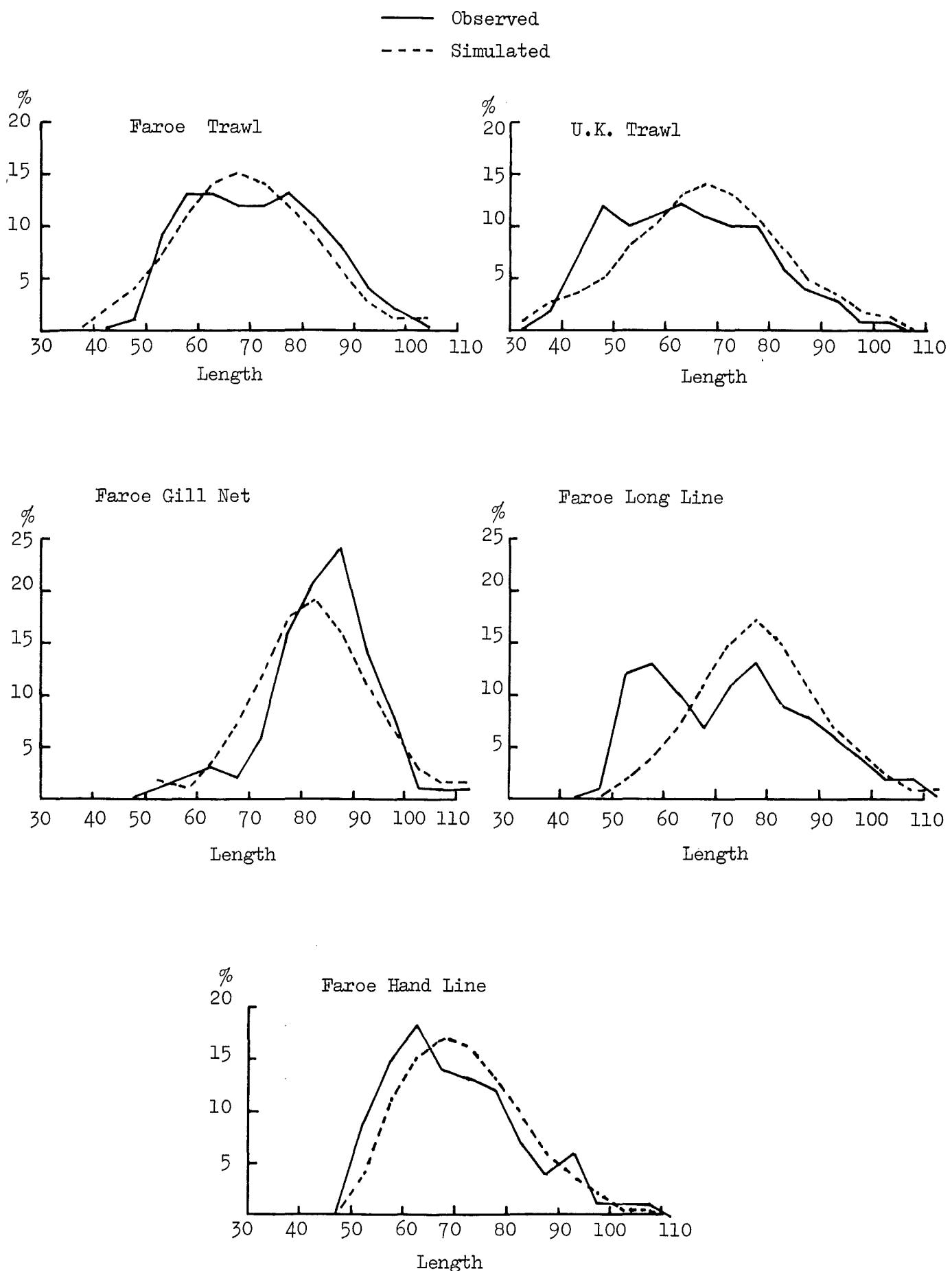
Figure 5. Cod. Observed and simulated percentage length frequency distributions.

Figure 6. Haddock. Observed and simulated percentage length frequency distributions.
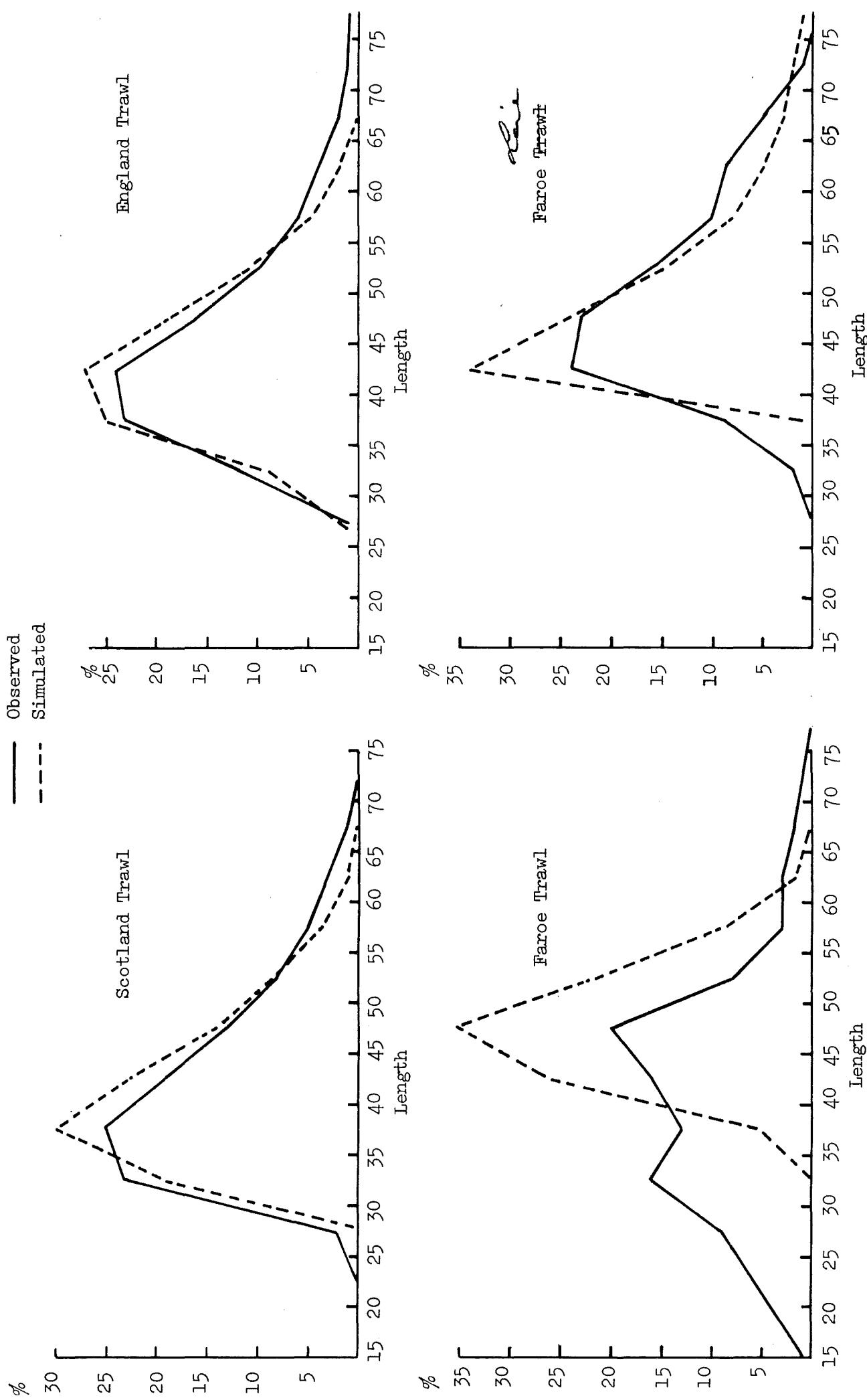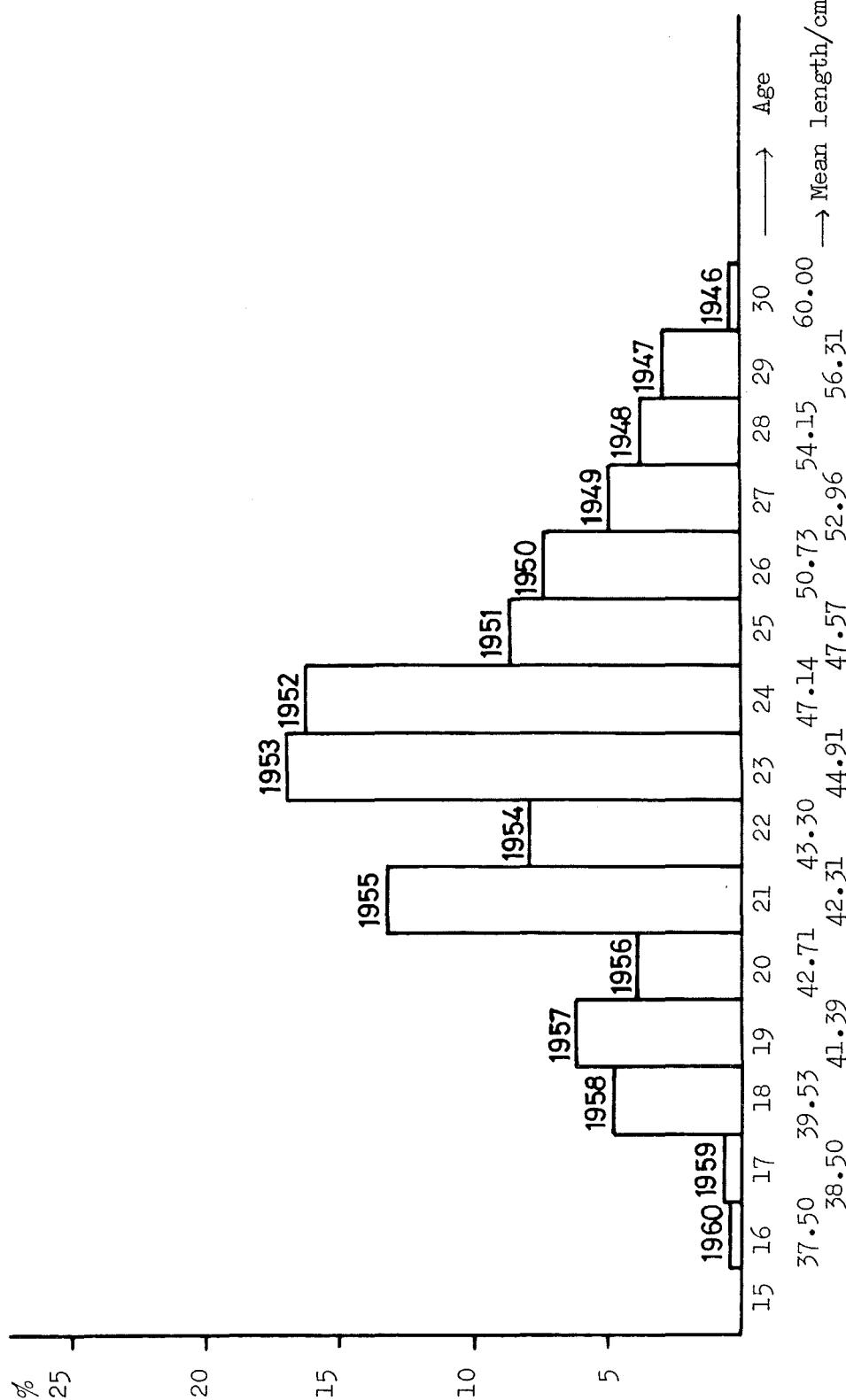
Figure 7. Age distribution of Redfish (S. marinus) at the Faroe Islands in 1976.
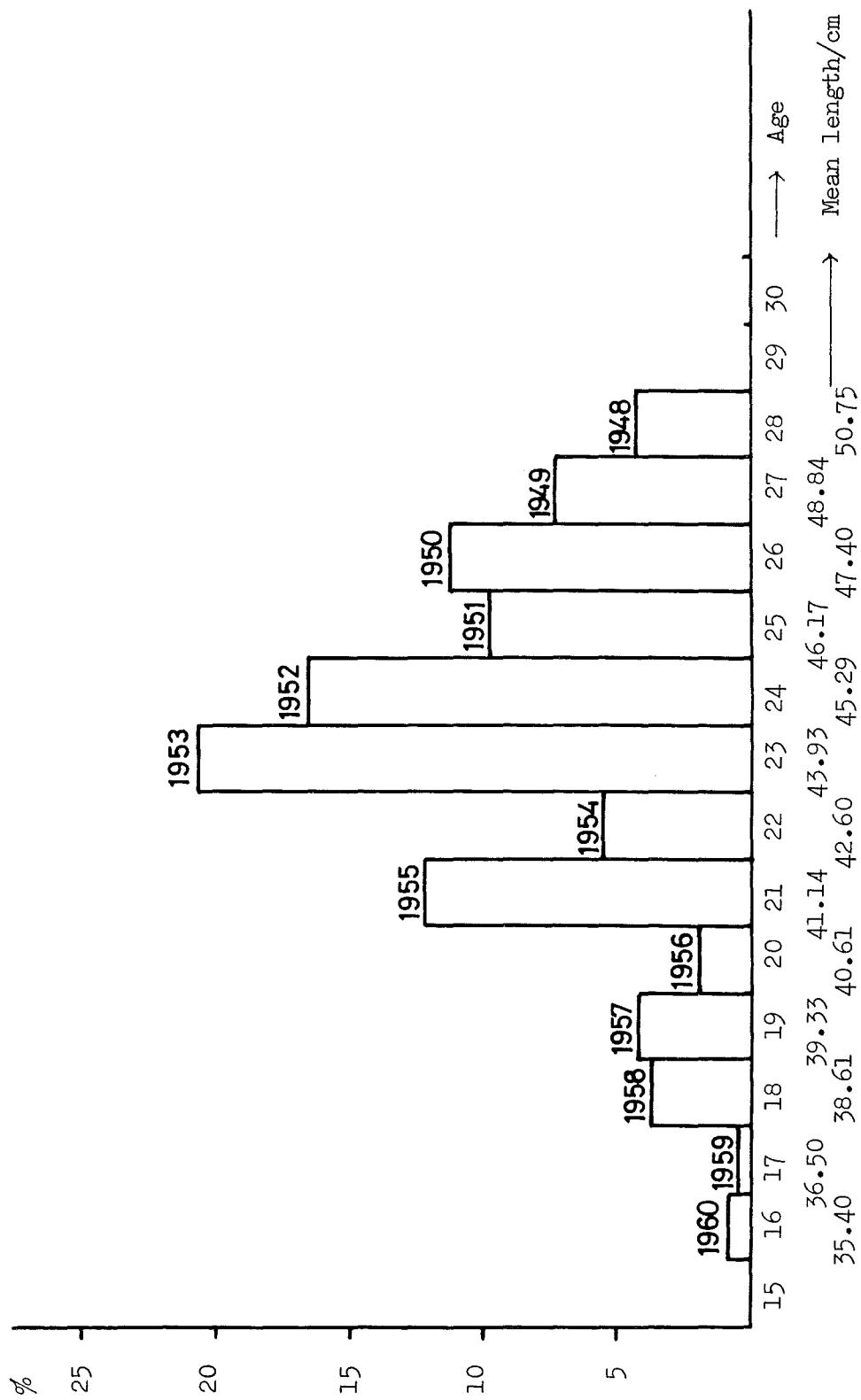
Figure 8. Age distribution of Redfish (S. mentella) at the Faroe Islands in 1976.