NORTH-WESTERN WORKING GROUP

Report of Meeting in Copenhagen, 27. February - 6. March, 1961

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Terms of Reference

At the Eighth meeting of the Permanent Commission, London, in May 1960, the Liaison Committee of I.C.E.S. was invited to "promote an investigation into the state of the fish stocks in the northern part of the Convention Area outside the north-east Arctic, and the effects on them of further increases of mesh size above 110 mm".

In response to this request the Liaison Committee, at a meeting in London on 5. May 1960, set up the North-Western Working Group, constituted as above, and asked it as first priority to report on the fisheries of Iceland and East Greenland, to which the request of the Permanent Commission referred explicitly. It further asked the Group to examine the effect of increase in mesh size on the fisheries of the Faroes area.

Scope of this Report

From the research and statistical data submitted by members of the Group, together with the results of previous investigations, it was possible to reach certain conclusions for most of the important fisheries not only of Iceland and East Greenland but also of the Faroes. This report is accordingly presented in three parts, viz:-

Part I. The fisheries of Iceland and East Greenland.
Part II. The fisheries of the Faroes area.
Part III. Recommendations for future work.

The treatment adopted throughout is to consider first the evidence for the effect of fishing on the stocks in question, and then to give, where possible, assessments of the effect of increase of mesh size. Some general remarks on these assessments are as follows:-

(a) The assessments give the expected change, as a pencentage by weight of landings, with reference to what is judged

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to be the contemporary situation so far as the intensity of fishing and its distribution is concerned.

(b) Immediate losses are calculated from the size compositions of the landings and the selectivity of the gear. Long-term assessments are based on the size composition of the landings and on the proportion (E) of the fish released which can be expected to be subsequently caught.

(c) No allowance is made in these assessments for any change of fishing tactics or increased fishing power of trawl gear which might be expected to result from an increase in size of mesh. Both of these factors will tend to increase the proportion of the total catch taken by the regulating gears (trawls) compared with the figures quoted.

(d) Mesh sizes quoted refer to double manila.

Part I. THE FISHERIES OF ICELAND AND EAST GREENLAND

1. COD - ICELAND

1.1 Effects of fishing

Published investigations by Jónsson (1) and Gulland (2) suggest that the mortality rate in the Icelandic stock of cod caused by fishing increases with age, and this can be seen from the age composition of the total catches by all gears, shown in Figure 1 (years 1955-59 combined).* The rate of decline of successive age-groups increases sharply to about 60% per year (of which about four-fifths is due to fishing) beyond an age of about ten years, which corresponds roughly to the average age at first maturity. If the natural mortality rate estimated for the mature stock (10% to 20% per year) is assumed to apply also to younger fish down to about five years of age, then it can be estimated from Figure 1 that the total mortality rate of fish between five and ten years of age is about 30% to 40% per year, of which about half is due to fishing.

The rate of decrease of these age-groups in the English trawl catches is considerably higher than this, but this can be explained by the fact that the trawler effort is concentrated mainly on the younger age-groups, and that as fish grow older they are progressively under-represented in the trawl catches (see Fig. 1).

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* This total age composition has been obtained as described in paragraph 1.4 for the length composition of the total catches.

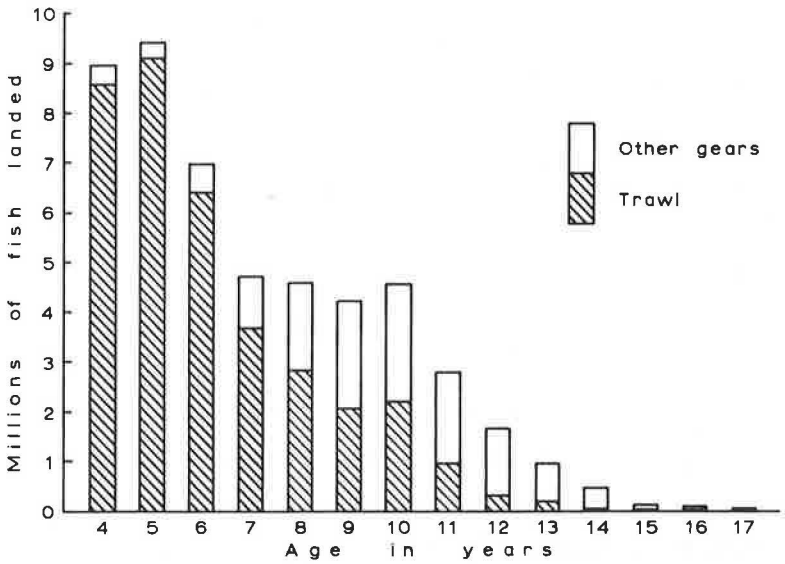

Figure 1. Region Va (Iceland) cod; age-composition of total landings (1955-59) by trawls and other gears.

In summary, it is concluded that the fishing rate in the immature stock which is fished primarily by trawlers, is lower than in the mature stock, which is fished also by long-lines and gill-nets. Although the ratio of fishing to total mortality is high in the mature stock (about 0.8) it is the value of this ratio among the first few age-groups above the mesh selection range which is primarily responsible for determining what proportion of the released fish are subsequently caught, and hence the gain to be expected from fish released by an increase in the size of mesh. Thus, for purposes of mesh assessment, a ratio of fishing to total mortality (denoted by the symbol E) in the region of 0.5 to 0.6 must be considered as the best estimate.

1.2 Selectivity

The selectivity factor adopted for Arctic cod on the basis of the 1959 International Mesh Experiment and other results is 3.6. Iceland cod are rather fatter than Arctic cod (Lundbeck (3)), and this would suggest that they may have a lower selection factor. Values of 3.4 and 3.6 have therefore been used for assessments; these lie within the range reported by Jónsson (4) for Iceland cod.

A selection range of 10 cm between the 5% and 95% retention points, and 8 cm between the 25% and 75% retention points, as determined for Arctic cod, has been used. The 50% selection lengths for mesh sizes from 110 mm to 140 mm, calculated from each of the two selection factors, are given in Table 1.

Table 1. Iceland cod; 50% selection lengths for various mesh sizes

Mesh size (mm)	50% selection length (cm)	
	Selection factor 3.4	Selection factor 3.6
110	37.4	39.6
120	40.8	43.2
130	44.2	46.8
140	47.6	50.4

1.3 Growth and weight/length data

Although the weight-at-age of cod differs appreciably between the north and south coast, the rate of growth of fish over the selection range of the meshes considered (35 cm to 55 cm) is very similar in both areas (Jónsson) (see Fig. 2). Weight/length data for cod, also supplied by Jónsson, is shown in Table 2.

Table 2. Iceland cod; weight/length data

Mid-point of 5 cm length group	Average weight (kg) (gutted, heads on)
30	0.40
35	0.50
40	0.65
45	0.85
50	1.20
55	1.50
60	1.90
65	2.40
70	2.95
75	3.50
80	4.10
85	4.75
90	5.50
95	6.5
100	7.5
105	8.7
110	10.0
115	11.6
120+	13.0

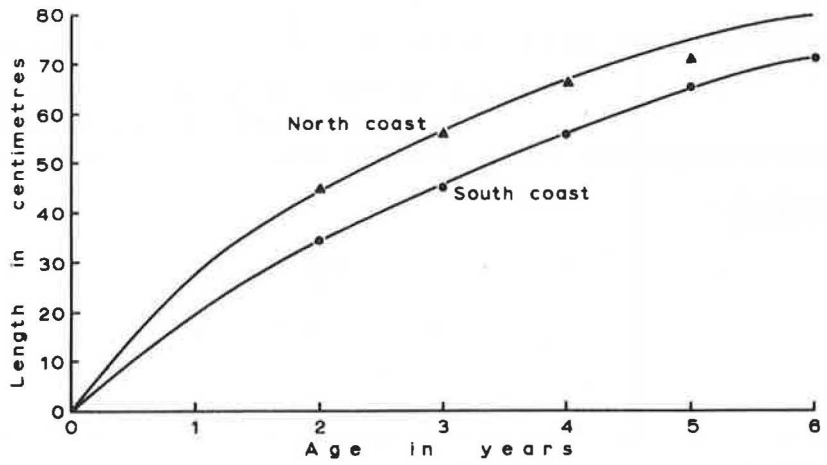

Figure 2. Iceland cod; growth in length.

1.4 Length composition of commercial landings

Data for the years 1955-59 combined were taken as the basis for assessment, since these reflect reasonably well the contemporary level of fishing effort. Detailed length compositions of the landings over this period were available for the following fleets:-

Icelandic	long-line
Icelandic	gill-net
English	trawl
German	trawl

From a few samples of Icelandic trawl landings it seemed that their length composition corresponded most nearly to those of German trawlers. No data were available for Faroese trawl landings, but from the season and area in which Faroese trawlers fish at Iceland, it seemed that these, too, would be best represented by the length composition of the German landings. Landings by Scottish and Belgian trawlers were taken as having the same length composition as those of English trawlers. Finally, the Norwegian and Faroese long-line catches were taken as having the same size composition as those of Icelandic long-line catches.

Thus, for purposes of assessment, three groups of gear have been distinguished, the landings of which have characteristically different size compositions. These, together with their total landings of cod for the years 1955-59, are given in Table 3.

Table 3. Iceland cod; landings by gears as grouped for mesh assessment

Fleet	Average annual landings of cod, 1955-1959 (metric tons, round fresh)	
Trawl Group A		
England	136,221	
Belgium	8,168	145,551
Scotland	1,162	
Trawl Group B		
Germany	35,669	
Iceland	86,228	142,231
Faroes	20,334	
Other gears		
Iceland, Norway, Faroes long-line	36,437 / 6,410 / 12,200	55,047
Iceland gill-net	149,950	
Total	492,779	

The length composition of the landings of each of these groups of fleets and the total for all gears, for the years 1955-59, is shown in Figure 3 (in millions of fish).

It is known that a small proportion of the catches of English trawlers is discarded at sea at certain seasons and areas. A few estimates of discards both by observers on commercial vessels and by reports from skippers indicate that an average of 5% by weight is a reasonable figure to take for discards from English trawlers.

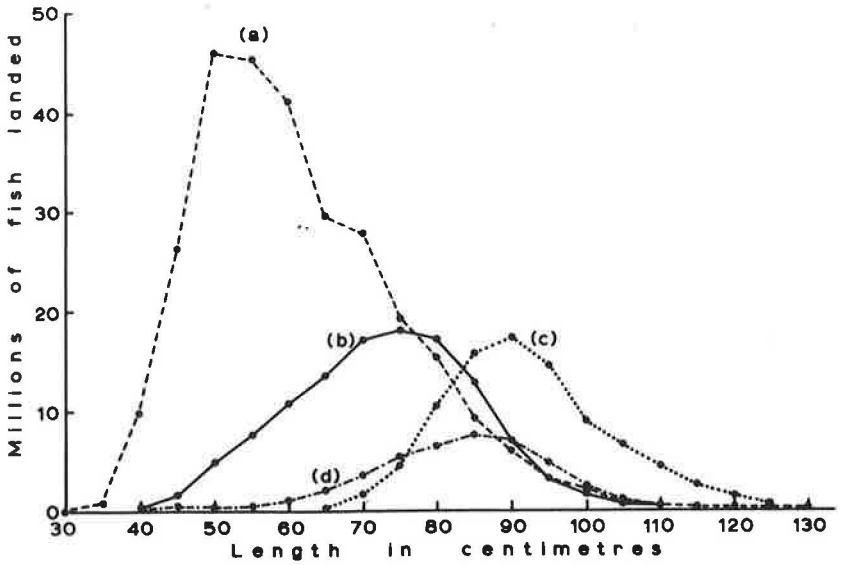

Figure 3. Region Va (Iceland) cod; length composition of landings (1955-59) by gears as grouped for mesh assessment. (a) Trawl: England, Belgium, and Scotland; (b) Trawl: Germany, Iceland and Faroes; (c) Long-line: Iceland, Faroes and Norway; (d) Gill-net: Iceland.

1.5 Mesh assessments

Assessments were made by Gulland's method (Gulland (5)), for increases of trawl mesh size from 110 mm to 120 mm, 130 mm and 140 mm. The immediate losses and long-term changes are summarized in Table 4.

Remembering that the true value of E for the size of fish released is probably nearer 0.5 than 0.7, the general conclusions which emerge from Table 4 can be summarized as follows:-

(a) There would be a long-term gain in total catch with increase of trawl mesh size from 110 mm up to 140 mm at least. At 140 mm the gain would be in the region of 5%.

(b) The greatest long-term gain would be to the non-regulating gears; this would be in the region of 5% with a trawl mesh of 130 mm, and 8% with a trawl mesh of 140 mm.

(c) The trawler fleets as a whole would receive long-term gains of between 1% and 4% from an increase of mesh to 130 mm, and between 3% and 6% from an increase to 140 mm.

(d) Trawl Group B would have long-term gains similar to, but a little smaller, than those of the non-regulating gears.

(e) Most of the fish released by an increase in mesh size would come from Trawl Group A, and so this group would have the smallest long-term gains.

Table 4. Region Va (Iceland) cod; mesh assessments

Fleet	E	Selection factor 3.4						Selection factor 3.6					
		110/120 mm		110/130 mm		110/140 mm		110/120 mm		110/130 mm		110/140 mm	
		Immediate loss %	Long-term gain %	Immediate loss %	Long-term gain %	Immediate loss %	Long-term gain %	Immediate loss %	Long-term gain %	Immediate loss %	Long-term gain %	Immediate loss %	Long-term gain %
Trawl A (England) (Belgium) (Scotland)	0.5	0.7	0.8	2.4	1.2	4.5	1.1	1.4	1.0	3.8	1.2	7.6	0.06
	0.7		1.5		2.4		3.5		1.9		3.2		3.1
Trawl B (Germany) (Iceland) (Faroes)	0.5	0.06	1.5	0.2	3.3	0.6	5.4	0.1	2.3	0.5	4.7	1.1	7.1
	0.7		2.1		4.7		7.7		3.2		6.7		10.3
Total trawl	0.5	0.5	1.1	1.6	1.9	3.0	2.7	0.9	1.4	2.5	2.6	5.1	2.7
	0.7		1.7		3.2		5.0		2.4		4.5		5.9
Other gears	0.5	-	1.6	-	3.5	-	5.9	-	2.4	-	5.2	-	8.2
	0.7		2.2		4.9		8.3		3.4		7.2		11.2
Total (all gears)	0.5	0.25	1.2	0.9	2.6	1.7	4.1	0.5	1.9	1.4	3.7	2.9	5.1
	0.7		1.9		4.0		6.5		2.9		5.8		8.3

2. COD - EAST GREENLAND

Age-composition data of catches taken in recent years by both trawl and long-line are available from Icelandic, German, and Norwegian sources. These show a striking similarity of year-class strength to those in the Icelandic stock, as has been reported by Jónsson (6). The relative abundance of the older fish is, however, greater at East Greenland, as would be expected if the stock there were less heavily fished (see Figure 4).

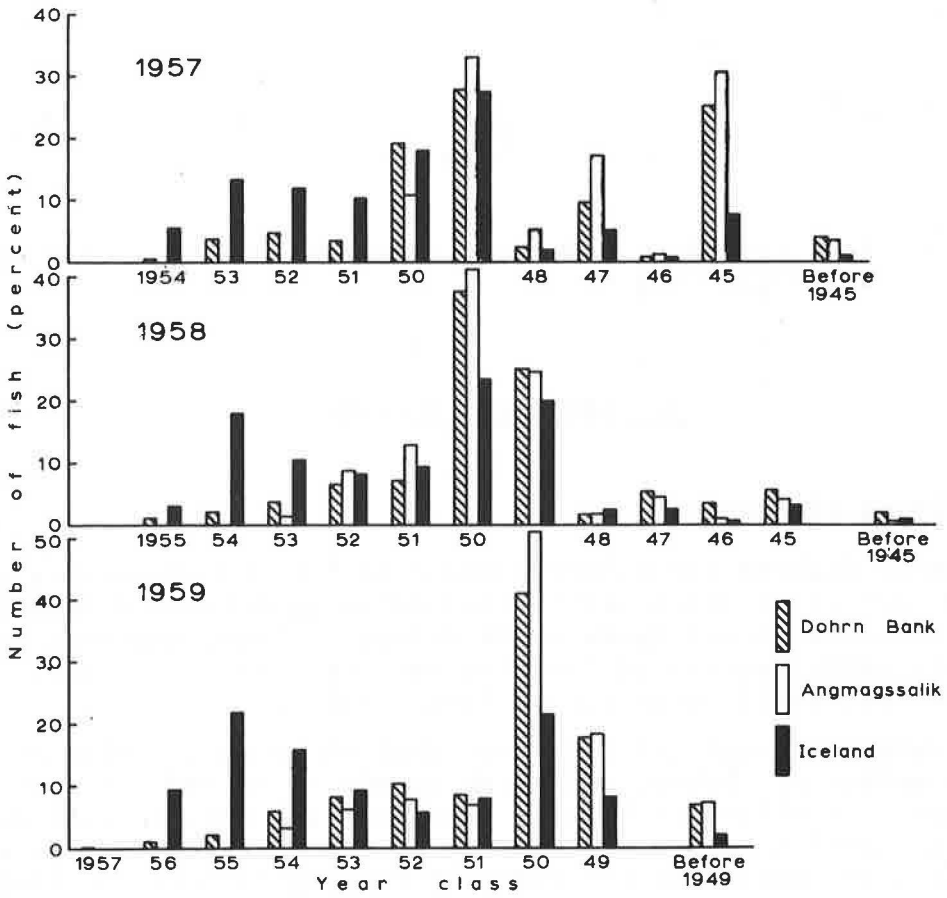

Figure 4. East Greenland cod; age-composition of German landings, 1957-59.

From the point of view of mesh assessment the important finding is that small fish within the range of size released by meshes up to 140 mm are virtually absent in trawl samples from East Greenland (Figure 5). Thus, it follows that increase of mesh size to at least 130 mm would not affect the present catches of cod at East Greenland.

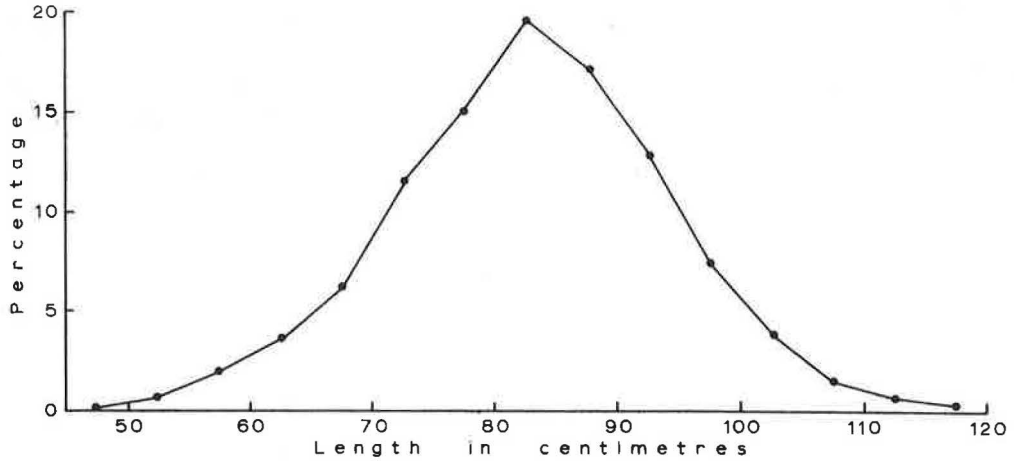

Figure 5. East Greenland cod; length composition of German trawl landings, 1955-59.

3. HADDOCK - ICELAND

3.1 Effects of fishing

There is no fishery for mature haddock at Iceland comparable to that for cod, and it is not possible from existing data to determine mortality rates which are known to be reliable. Thus, apparent total mortality rates calculated from the age composition of trawl catches increase continually with age of fish (Table 5).

However, Gulland (2) has shown that there is a marked relation between amount of fishing and stock abundance as estimated from the catch per unit effort of English trawlers, and that fishing has reduced the stock to about one-quarter of its unfished abundance. On this basis it seems that the ratio of fishing to total mortality relevant to mesh assessment in Icelandic haddock is somewhat greater than in cod. Assessments have accordingly been made with values of E from 0.6 to 0.8. Values of the natural mortality coefficient (M) of 0.1 and 0.3 have been used.

It may be noted that Gulland has shown that the values of catch per unit effort for English trawlers in recent years have been substantially higher than would be expected from the relation between catch per unit effort and amount of fishing based on earlier years. This increase started shortly after the increase of mesh to 110 mm and the closure of the nursery grounds of Faxa Bay, and can be reasonably taken as a practical demonstration of the gain from allowing small fish to escape capture.

Table 5. Region Va (Iceland) haddock; age composition (°/oo) of German trawl landings (figures in brackets are estimated)

Year \ Age	3	4	5	6	7	8	9+
1955	7	87	367	467	(40)	(20)	(12)
1956	2	89	356	338	188	(16)	(11)
1957	12	67	236	430	202	45	8
1958	12	82	166	193	363	135	49
1959	39	180	231	180	148	174	48
Total	72	505	1,356	1,608	941	390	128
Apparent survival rate (%)		700	268	118	58	41	33
Apparent total mortality coefficient (Z)				-0.17	0.54	0.89	1.40

3.2 Selectivity

Only a few selectivity data for haddock are available (Jónsson (4)), and these are not inconsistent with the results obtained for Arctic haddock (Report of Mesh Selection Working Group). Two selection factors have been used for the assessments, 3.2 and 3.4; the former corresponds to the value for North Sea haddock, the latter to that for Arctic haddock. The selection range used is the same as that for cod.

3.3 Growth and weight/length data

The growth-rate of haddock over the selection range of the meshes considered is shown in Figure 6 (data supplied by Jónsson).

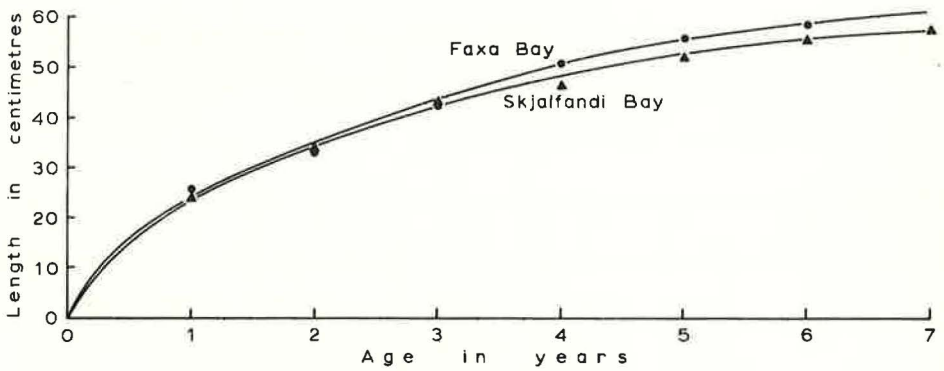

Figure 6. Iceland haddock; growth in length.

3.4 Length composition of commercial catches and landings

Data for the years 1956-59 combined were used for assessments, these being available only for the following trawl fleets:-

Trawl	England
	Scotland
	Germany

Each of the above trawl landings showed significantly different size compositions and assessments were made for each separately. To obtain the size compositions of the total landings, Belgian trawl landings were taken as having the same size composition as English, and Icelandic and Faroese trawl landings the same as German. For the other gears, mainly Icelandic long-lines, the numbers caught were estimated from the weight caught using an average weight per fish of 1.5 kg.

Thus, for purposes of assessment, four groups of fleets have been distinguished, as in Table 6.

Length compositions of the landings of each of the trawl fleets for the years 1956-59, are shown in Figure 7 (10,000's of fish).

Discards from English trawlers have been estimated from observations at sea as rather under 10% of the catch by numbers.

Table 6. Iceland haddock; landings by gears as grouped for mesh assessment

Fleet	Average landings of haddock, 1955-59 (in tons, round fresh)
Trawl Group A England and Belgium	32,728
Trawl Group B Scotland	696
Trawl Group C Germany, Iceland, Faroes	12,856
Other gears	21,386
All gears	67,666

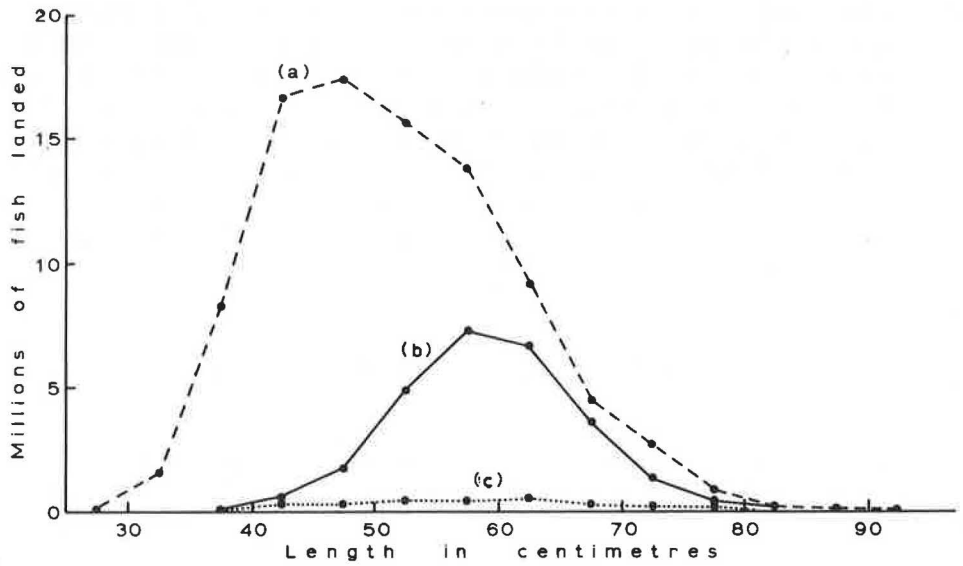

Figure 7. Region Va (Iceland) haddock; length composition of trawl landings, 1956-59. (a) England and Belgium; (b) Germany, Iceland and Faroes; (c) Scotland.

3.5 Mesh assessments

Immediate and long-term changes for increases in trawl mesh size from 110 mm to 120 mm, 130 and 140 mm are summarized in Table 7. The general conclusions to be drawn from this Table can be summarized as follows:-

(a) There would be a long-term gain in total catch, of roughly 5%, with increase of trawl mesh to 130 mm. A mesh of 140 mm might not produce any further gain, but there would still be a gain compared with a mesh of 110 mm.

(b) Other (non-regulating) gears would obtain increasing long-term gains for increase of trawl mesh up to 140 mm. For a trawl mesh of 130 mm the gain to other gears would be in the region of 12% to 20%.

(c) The trawler fleets as a whole would probably receive small long-term gains from increase of mesh to 130 mm; but these would be reduced by a further increase in mesh size.

(d) Trawl Group C would also obtain progressively greater long-term gains for increase of mesh size up to 140 mm. With a mesh size of 130 mm, the gain would be in the region of 10%.

(e) Trawl Group B would obtain long-term gains of about 5% for increases of mesh up to 130 mm, but a further increase in mesh size to 140 mm would produce little further gain.

(f) The long-term assessments for Trawl Group A for mesh sizes up to 130 mm range from small losses to small gains accordir to the particular values of E, M, and selection factor used. Thus for this group of trawlers it is concluded that the loss of fish released by meshes up to 130 mm would be nearly balanced by the gains obtained from them subsequently. A further increase of mesh to 140 mm would, however, probably produce a small long-term loss of a few per cent.

4. OTHER SPECIES

Of other species of commercial importance at Iceland and East Greenland, some statements can be made concerning redfish, coalfish, and plaice.

4.1 Redfish

As in many other redfish fisheries of the North Atlantic, catches on many of the various local fishing grounds within the Icelandic area have declined as fishing has intensified. This is not always evident from published data relating to the main statistical areas because new local grounds have been opened up as catches on older grounds have declined. This evidence strongly suggests a local effect of fishing, but it cannot yet be established conclusively what has been the effect of fishing on the stocks as a whole.

Table 7. Region Va (Iceland) haddock; mesh assessments

Fleet	E	Selection factor = 3.2						Selection factor = 3.4	
		110 mm to 120 mm		110 mm to 130 mm		110 mm to 140 mm		110 mm to 140 mm	
		Imm. loss %	Long-term gain %	Imm. loss %	Long-term gain %	Imm. loss %	Long-term gain %	Imm. loss %	Long-term gain %
Trawl A (England and Belgium)	0.6	3	-0.5	8	-1.5	13.6	-3.7	20.7	-8.0
	0.7		0		-0.5		-2.0		-5.8
	0.8		0.7		0.7		-0.2		-3.9
Trawl B (Scotland)	0.6	1.5	1.5	4	2.8	7.6	3.0	11.7	2.4
	0.7		2.2		3.8		4.7		4.8
	0.8		2.5		5.0		6.7		7.0
Trawl C (Germany + Faroes + Iceland)	0.6	0.2	2.8	1	6.1	2.5	7.8	5.4	9.8
	0.7		3.5		7.2		10.6		12.4
	0.8		4.0		8.5		12.7		14.7
Total trawl	0.6	2.8	0.4	5.9	0.8	10.7	-0.5	16.1	-2.7
	0.7		1.1		1.8		1.2		-0.4
	0.8		1.6		3.0		3.1		1.7
Other gears	0.6	-	3.3	-	7.1	-	11.5	-	16.0
	0.7		4.0		8.2		13.4		18.8
	0.8		4.5		9.5		15.5		21.2
Total (all gears)	0.6	2.8	1.4	4.2	2.6	7.5	3.1	11.3	2.8
	0.7		2.0		3.6		4.8		5.3
	0.8		2.6		4.8		6.8		7.5

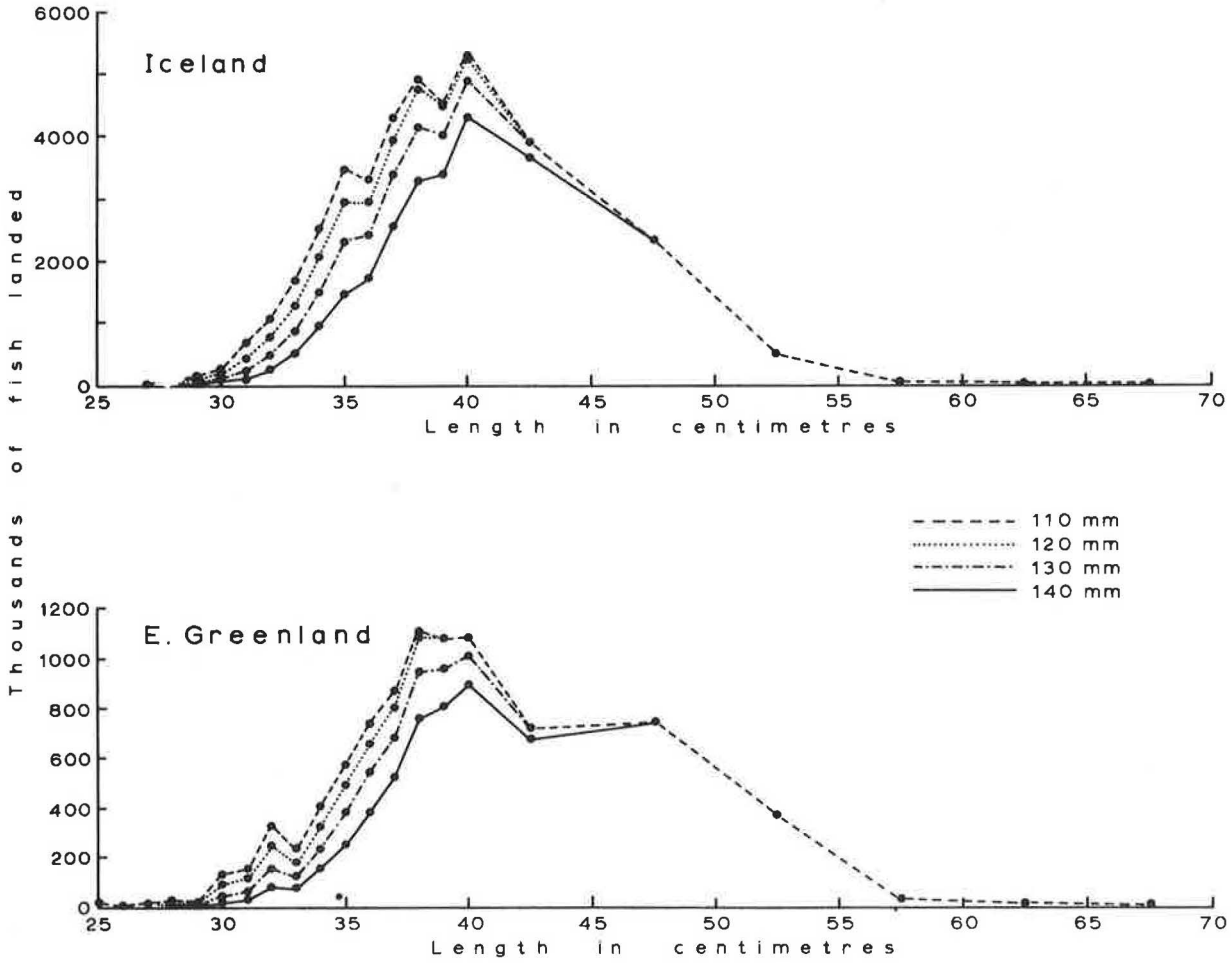

Figure 8. Iceland and East Greenland redfish; length composition of German landings, 1958-59, showing the estimated immediate losses due to mesh sizes greater than 110 mm.

From the length composition of the German landings of redfish from Icelandic and East Greenland waters in 1958 and 1959 (see Figure 8), and the selectivity data [1] for redfish published by von Brandt (7) and Saetersdal (8), it is possible to estimate the immediate loss resulting from increases of trawl mesh above 110 mm. These are summarized in Table 8, and can be taken as applying to Icelandic trawl catches as well as to German.

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1) These estimates come from experimental hauls in which the average quantity caught was probably less than is typical of the commercial fisheries, but there is evidence (von Brandt (7)) that the selection factor of redfish decreases as the catch increases. For this reason, the selection factor of 2.6 used here, and hence also the assessments of immediate loss of Table 8, may be too large.

Table 8. Immediate losses (%) for redfish with increase of mesh above 110 mm, based on German trawl data

Increase of mesh from 110 mm to:-	Iceland (1959)	East Greenland (1958 and 1959)
120 mm	2.3	1.6
130 mm	7.0	5.1
140 mm	14.1	10.2

No new information on the problem of "meshing" of redfish was available to the Group. It was noted, however, that for redfish at West Greenland, where the size composition is similar to that at Iceland and is substantially larger than at Labrador or Newfoundland, von Brandt has concluded that "meshing" of redfish would not prove a serious problem in the commercial fisheries with mesh sizes up to 130 mm.

4.2 Coalfish

German investigations on coalfish at Iceland have shown that extensive migrations from Norway have occurred in recent years. Although age-composition data for German trawl landings are available, these migrations make it difficult to obtain reliable measures of mortality from such data. However, Gulland (2) has shown that the abundance of the coalfish stock at Iceland, as measured by the catch per unit effort of English trawlers, has responded markedly to variations in the amount of fishing, and concluded that this species would benefit from protection of small fish by mesh regulation.

No selectivity results are available for coalfish, but the number of small fish within the probable selection range of meshes to 130 mm are so small in both the German and, to a lesser extent, English landings (see Figure 9) that it is unlikely that an increase of mesh to this size would have any appreciable effect.

4.3 Plaice

Virtually all the plaice in the commercial catches are above the selection range of meshes up to 130 mm, and so increases of mesh up to this size would have little effect. Gulland (2) has shown, nevertheless, that the stock of plaice at Iceland is fairly heavily fished, and it can safely be concluded that any fish which may be released by meshes up to at least 130 mm would result in a long-term gain.

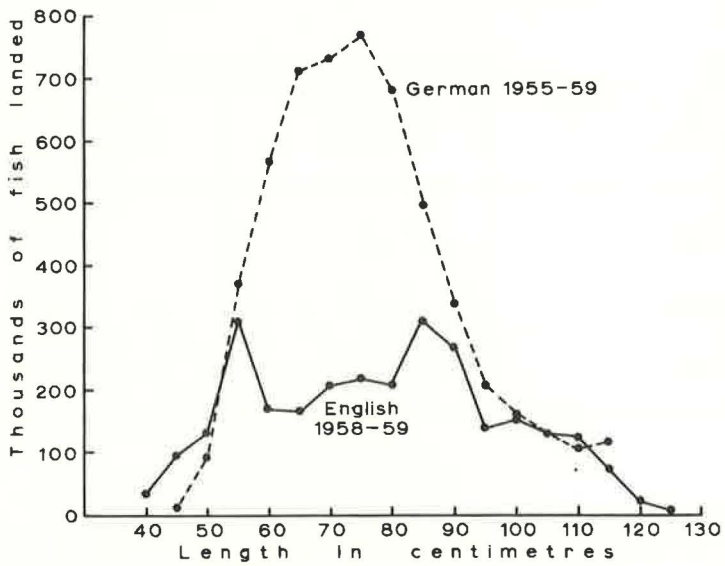

Figure 9. Region Va (Iceland) coalfish - length composition of German (1955-59) and English (1958-59) trawl landings.

PART II. FISHERIES OF THE FAROES AREA

5. COD

5.1 Effects of fishing

The only series of age-composition data for Faroe cod are of Joensen for the years 1933 - 1939 and 1951 onwards (Joensen, (9) and recent data), which give estimates of total mortality rate in the region of 50% per year. During these periods there have not, however, been striking changes in the amount of fishing and consequently the data do not enable separate estimates of fishing and natural mortality rates to be obtained.

Fairly reliable estimates of stock abundance for a longer period (since 1922) can be obtained from the catch per unit effort of English trawlers. These are shown in Figure 10 plotted against the total amount of fishing. A definite relation is evident, broadly similar to that for the immature part of the Icelandic cod stock (Gulland (2)), and from which it appears that at present levels of fishing the stock has been reduced to about half its unfished abundance.

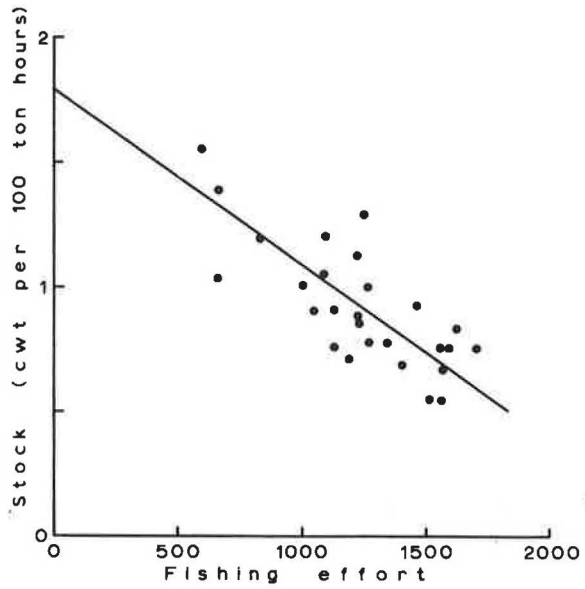

Figure 10. Region Vb (Faroe) cod. Relation between stock and fishing effort, based on English landings per unit effort and estimates of total effort in English trawl units.

It is therefore concluded provisionally that the stock of cod at Faroes is only moderately fished, and values of E of 0.3, 0.5, and 0.7 have been used for assessments.

5.2 Selectivity

No selectivity data exist for cod at Faroes, but there is no reason to believe that selectivity differs materially from what has been obtained in the North Sea and Arctic. A selectivity factor of 3.4 has therefore been used for assessments, with the same selection range as specified for Icelandic cod in paragraph 1.2.

5.3 Growth

Growth data used were those shown in Figure 11 (from data of Tåning (10)).

5.4 Length composition of commercial landings

Data of landings for three groups of fleets are available for recent years, having differing size compositions, and are as follows:-

English (trawl)	1958 and 1959
Scottish (trawl)	1959
Faroese (long-line)	1951-1959

Separate assessments have been made for each of these groups, which together account for about 95% of the total catch of cod at Faroes, see Table 9.

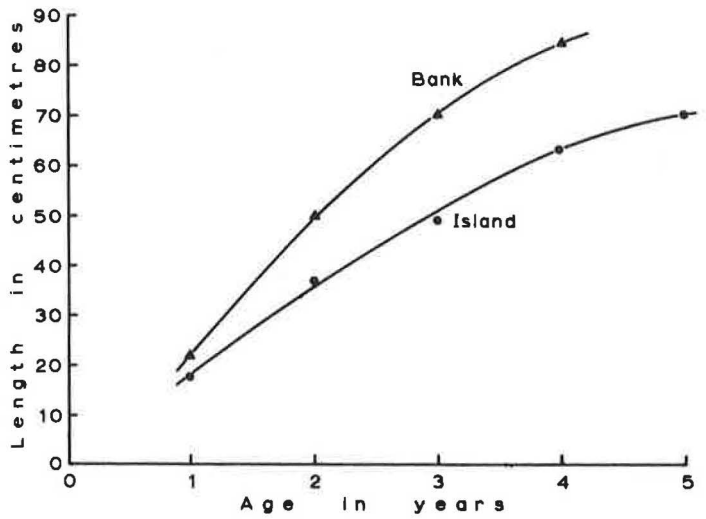

Figure 11. Faroe cod. Growth in length.

Table 9. Faroe cod; landings by gears as grouped for mesh assessment

Fleet	Total landings of cod (1955-59) (in tons, round fresh)
Scotland (trawl)	11,307
England (trawl)	11,103
Faroes (long-line)	6,794
Total (all gears)	29,204

A quantity of cod are landed by German trawlers but these probably contain few small fish, and will be little affected by an increase in mesh size. The length composition of the landings of these groups of gears are shown in Figure 12 for the year 1959.

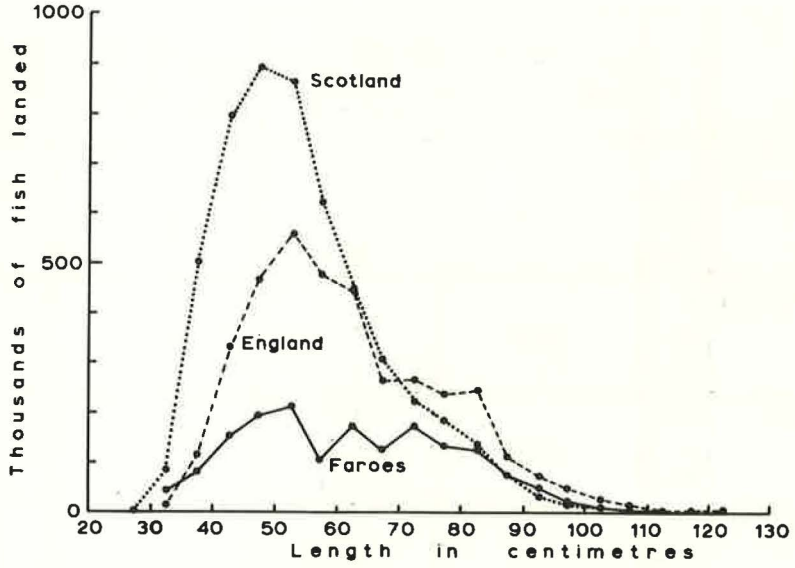

Figure 12. Region Vb (Faroe) cod. Length composition of 1959 landings by gears as grouped for mesh assessments.

No account has been taken of discards in the assessments, although a small amount of data from Scottish and English trawlers indicate that discards of cod may be one or two per cent by weight of the catch.

5.5 Assessments of mesh increase

Taking the present mesh size in the Faroes as 75 mm, assessments have been made for increases of trawl mesh to 110 mm and to 130 mm. These are given in Table 10, from which the following conclusions emerge:-

(a) The total landings would be little affected by changes in mesh size up to 110 mm; with a mesh size of 130 mm there would probably be a small gain.

(b) Faroe long-line catches would have a long-term gain of about 3% for an increase of trawl mesh to 110 mm, and of 6% for an increase to 130 mm.

(c) Assessments for the trawler fleets as a whole range from small losses to small gains for mesh sizes of both 110 mm and 130 mm; the long-term effect is to this extent uncertain, but would not involve much change in either direction.

(d) English trawl landings would have small long-term gains about the same as those of total landings (see (a)).

(e) Scottish trawl landings would be hardly affected by increase of mesh to 110 mm; with an increase to 130 mm there would probably be a small long-term loss in the region of 2%-3%.

Table 10. Region Vb (Faroes) cod; mesh assessments

(Selection factor = 3.4)

Fleet	E	75 to 110 mm		75 to 130 mm	
		Imm. loss %	Long-term gain %	Imm. loss %	Long-term gain %
English trawl	0.3	1.5	0.1	4.1	-0.5
	0.5		1.2		2.0
	0.7		2.3		4.5
Scottish trawl	0.3	2.9	-1.3	7.6	-4.1
	0.5		-0.3		-1.7
	0.7		0.8		0.7
Total trawl	0.3	2.2	-0.6	5.9	-2.3
	0.5		0.4		0.1
	0.7		1.5		2.6
Long-lines (Faroes)	0.3	-	1.6	-	3.8
	0.5		2.7		6.4
	0.7		3.8		9.0
Total (All gears)	0.3	1.7	-0.1	4.5	-0.8
	0.5		1.0		1.6
	0.7		2.1		4.1

It should be noted that the small amount of cod discarded by trawlers at Faroes, which is not allowed for in these assessments, may well add gains of 1% or 2% to all fleets and so would tend to counteract the small long-term loss for Scottish trawlers quoted in the above table for a mesh size of 130 mm.

6. HADDOCK

6.1 Effects of fishing

Scottish research vessel age-composition data show a fairly high apparent total mortality rate in the region of about 60% per year (Parrish and Jones (11)). These authors concluded that fishing was responsible for the greater part of this total mortality. Recently, more detailed studies by Jones, which take into account the possibility that part of the stock may not be fished at any given time, agree with the earlier conclusions in ascribing the greater part of mortality to fishing.

Confirmatory evidence for this conclusion is provided by the relation between stock abundance and total fishing effort, based on Scottish statistics of landings per unit effort and effort since 1920. This is shown in Figure 13, from which it appears that the stock of Faroe haddock has been reduced by fishing to between one-third and one-quarter of its unfished abundance. A similar result is obtained if English statistics are used.

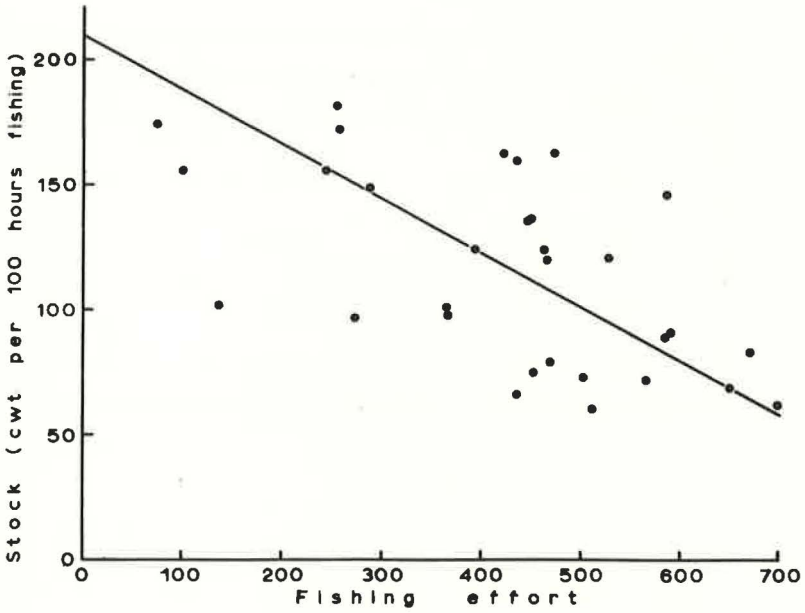

Figure 13. Region Vb (Faroe) haddock; relation between stock and fishing effort, based on Scottish landings per unit effort and estimates of total effort in Scottish trawl units.

Accordingly, it is concluded that the value of E for Faroe haddock is probably in the region of 0.6 to 0.8, and these two values have been used for assessments.

6.2 Selectivity

A selectivity factor of 3.2 has been used, based primarily on extensive data for North Sea haddock (see Report of Mesh Selection Working Group), together with a few results from Faroe haddock. The selection range for meshes of 110 mm and 130 mm has been taken as the same as in Iceland haddock, namely 18 cm between the 5% and 95% retention points, and 8 cm between the 25% and 75% points. The 50% selection lengths for various mesh sizes calculated from these figures are given in Table 11.

6.3 Growth

The growth-rate of fish in the selection range of the meshes considered is taken from recent Scottish research vessel and market data, (Figure 14).

Table 11. Faroe haddock; 50% selection lengths for various mesh sizes

Mesh size (mm)	50% selection length (cm)
75	24.0
90	28.8
110	35.2
130	41.6

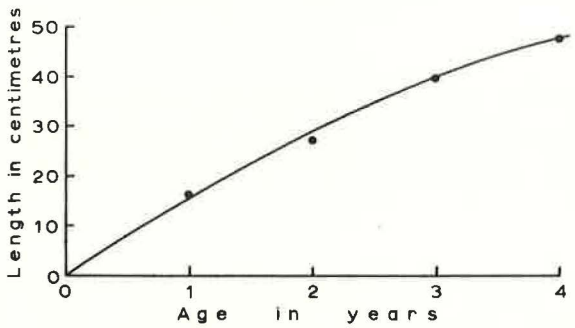

Figure 14. Faroe haddock; growth in length.

6.4 Length composition of commercial landings and catches

Length-composition data of commercial landings are available for the three main fleets, as follows:-

English trawlers	1957-1959
Scottish trawlers	1958-1959
Faroese long-lines	1960

These have rather differing length compositions (see Figure 15) and assessments have been made for each separately. The landings by each group for the years 1955-59, which account for about 95% of the total landings of Faroe haddock, are shown in Table 12.

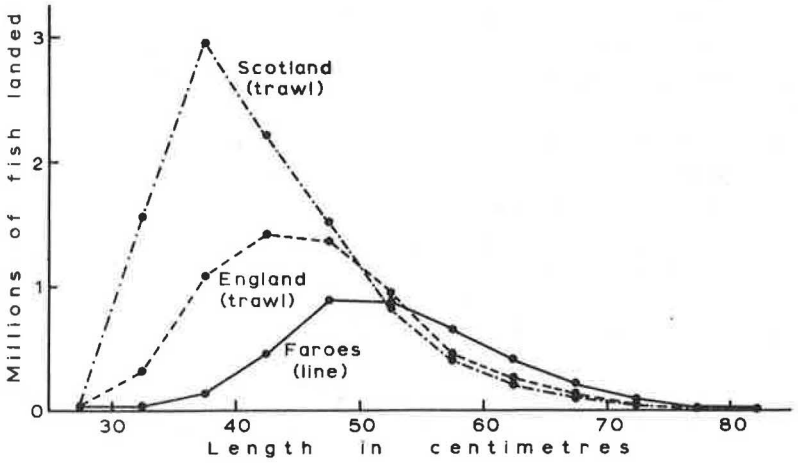

Figure 15. Region Vb (Faroe) haddock; length composition of recent landings by gears as grouped for mesh assessment.

Table 12. Faroe haddock; landings by gears as grouped for mesh assessment

Fleet	Average annual landings of haddock (1955-59) (in tons, round fresh)
Scotland (trawl)	8,714
England (trawl)	6,268
Faroes (long-line)	5,012
Total (All gears)	19,994

The proportion of fish discarded at sea by trawlers in the Faroe haddock fishery is exceptionally high compared with other fisheries considered in this report. A number of observations on discards from Scottish trawlers have been made (Jones (12)) over the period 1951-1956, giving proportions ranging from 5% to 60% of the catch by weight. The average quantity discarded was about 20% by weight, or in the region of 50% by numbers. Less data are available for English trawlers, but the observations that have been made (in 1959) also suggest that something in the region of 20% by weight is discarded. It can safely be assumed that few fish, if any, survive after being discarded. These high discard proportions are a major factor in determining the effect of increase of mesh size in the Faroe haddock fishery. Discards are high partly because the 50% selection length of a 75 mm mesh for haddock (about 24 cm) is substantially below the minimum legal size limit of 27 cm, and still further below the minimum size accepted by the markets; and partly because the nursery areas of the young fish are not clearly segregated from the main fishing grounds.

6.5 Assessments of mesh increase

Assessments have been made for increases of mesh size from 75 mm to 110 mm and to 130 mm, as for Faroe cod, and are shown in Table 13. Two estimates of the proportion of the catch discarded have been used, a lower one of 30% by numbers and an upper one of 60% by numbers; on present evidence it seems likely that the true average is nearer the upper figure than the lower. Taking these two estimates of discards cause the mesh assessments to vary numerically over a wide range; this reflects a real uncertainty in predictions of what the magnitude of the long-term effects would be. It is important to note, nevertheless, that all assessments give long-term gains, some of them very substantial in comparison with the assessments for other fisheries considered in this report. The general conclusions from Table 13 can be summarized as follows:-

(a) Substantial long-term gains in total catch would result from increase of trawl mesh; estimates range from 20% to 100% for an increase of mesh from 75 mm to 110 mm, and from 30% to 120% for an increase from 75 mm to 130 mm.

(b) Estimates of the long-term gain to non-regulating gears (long-lines) range from 30% to 120% for an increase of trawl mesh to 110 mm, and from 60% to 180% for an increase to 130 mm.

(c) There would also be substantial long-term gains to the trawl fleets from an increase of mesh to 110 mm, the estimates ranging from 16% to 95%. A further increase to 130 mm would leave the total gains to the trawl fleets virtually unchanged, but would cause the gains to the component fleets to differ rather more than at a mesh size of 110 mm.

Table 13. Region Vb (Faroe) haddock; mesh assessments

Fleet	Increase of mesh from 75 mm to 110 mm				Increase of mesh from 75 mm to 130 mm			
	Immediate loss (%)	E	Long-term gain %		Immediate loss (%)	E	Long-term gain %	
			Discards = 30% (nos.)	Discards = 60% (nos.)			Discards = 30% (nos.)	Discards = 60% (nos.)
Trawl (England)	11	0.6 0.8	19 29	68 95	20	0.6 0.8	29 45	86 123
Trawl (Scotland)	13	0.6 0.8	16 25	64 90	34	0.6 0.8	6 20	53 84
Total (trawl)	12	0.6 0.8	18 27	66 93	27	0.6 0.8	18 32	69 103
Long-line (Faroes)	-	0.6 0.8	34 45	90 120	-	0.6 0.8	60 81	132 178
Total (All gears)	9	0.6 0.8	22 32	73 100	20	0.6 0.8	28 45	86 122

7. OTHER SPECIES

Some remarks are offered here for redfish and coalfish in the Faroes area which are of importance to certain countries.

7.1 Redfish

As in the case of redfish at Iceland, no analysis of the effect of fishing on Faroe redfish has been attempted from existing data. Length measurements of German landings in 1959 (see Figure 16) from an area which included both Faroe grounds and also the Rosengarten (but primarily the former) may be used to gain some idea of the immediate loss to be expected from increase of mesh size above 110 mm (the present mesh size in use by German trawlers being about 110 mm). The same selectivity values as specified in para. 4.1 for Icelandic redfish have been used.

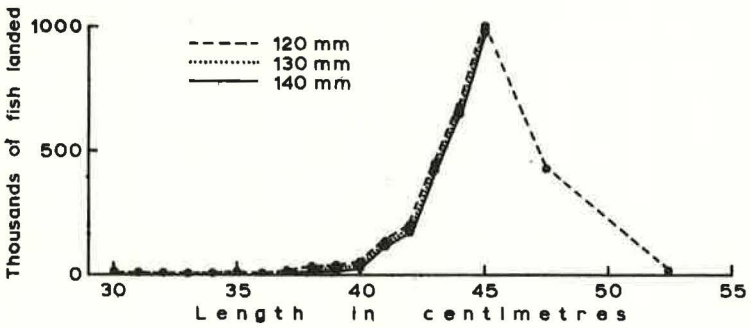

Figure 16. Region Vb (Faroe) redfish; length composition of German landings in 1959, showing immediate effect of mesh change.

Table 14. Faroe redfish (German landings); immediate losses (%) with increase of mesh above 110 mm

Increase of mesh from 110 mm to	Immediate loss (%)
120 mm	Nil
130 mm	0.3
140 mm	1.5

7.2 Coalfish

Length-composition data of German landings of coalfish from the Faroes area in the years 1956-1959 show that virtually no fish below 50 cm are landed (Figure 17). Data of English landings in 1958 and 1959 include rather more smaller fish and the length-composition is rather different between the two years. However, even taking the 1959 data, in which the small fish are the more numerous, it seems that increases of mesh size up to 130 mm would have very little effect on the landings, as judged from both the German and English data.

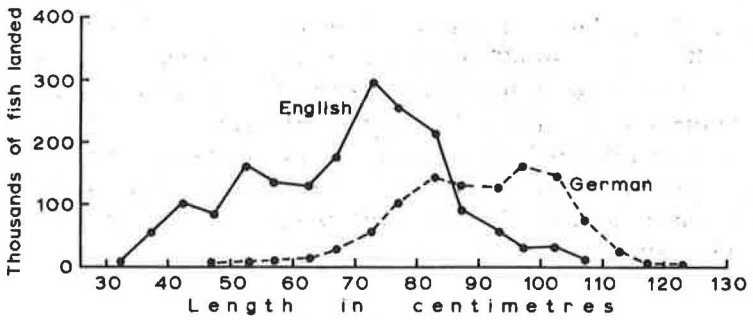

Figure 17. Region Vb (Faroe) coalfish; length composition of recent German and English landings.

PART III. RECOMMENDATIONS FOR FUTURE WORK

The investigations of the Working Group have brought to light certain gaps in the present knowledge of the stocks and fisheries of Iceland and the Faroes, which are relevant to problems of assessment.

The Group therefore wishes to put forward the following recommendations for the consideration of the Liaison Committee.

1. Selectivity data for cod, haddock, redfish, and coalfish in Icelandic waters are needed. It is thought that these could most effectively be obtained by an international experiment along the lines of those carried out in the North Sea and the Arctic in 1959 and 1960. Accordingly, the Group recommends that the attention of the Chairman of the Comparative Fishing Committee be drawn to this proposition at an early date, with a view to planning an experiment of this kind at the 1961 meeting of the Council.

2. Some selectivity data for cod and haddock at the Faroes exist, and it is recommended that these be worked up as soon as possible so that the question of whether further selectivity work is needed can be determined.

3. Co-ordination of techniques of age determination is needed for cod and perhaps other species in the areas considered in this report. Members of the Group have arranged to exchange material, and will bring the matter to the attention of the Gadoid Fish Committee at its 1961 meeting.

4. It seems that a proper understanding of the effects of fishing on the redfish stocks in the areas considered in this report, as in other parts of the North Atlantic, may require a more detailed regional breakdown of commercial statistics of catch and effort than is available at present. The Group therefore wish to recommend to the Chairman of the Statistical Committee that this matter be included in the agenda of the 1961 meeting of his Committee.

5. It will be noted in para. 6.5 that relatively large long-term gains are predicted to result from increase of mesh size in the Faroe haddock fishery to 110 mm and above. It is recommended that, if any such increase is made, consideration should be given to promoting suitable scientific investigations so that the changes in the stocks due to the mesh increase can be demonstrated and distinguished from natural changes.

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