International Council for the
Exploration of the Sea

C.M. 1963
Near Northern Seas Committee
No. 59 C

The Whiting Fisheries of the Irish Sea

by

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Introduction

With regard to the minimum mesh provisions of the 1946 Convention, it has been submitted to the Permanent Commission that in certain areas fishermen depend for their subsistence upon stocks of whiting (Gadus merlangus L.) whose main bulk lies at sizes that would not be captured in quantity if the minimum mesh size (70 mm) were enforced. In October 1960 a Committee established by the Permanent Commission met to examine the problems relating to these fisheries, and recommended that further research should be undertaken on the stocks in question.

This report summarises the preliminary conclusions of a Working Group set up by England, Scotland and Northern Ireland and the Republic of Ireland, to investigate the whiting fisheries of the Irish Sea.

The Magnitude of the Fisheries

Table 1 gives the total landings of whiting from Region VIIA by England, Northern Ireland and the Republic of Ireland. These are given as gutted weight though an unknown proportion of Irish catches is landed whole.

Table 1 Total landings of whiting from Region VIIA by England, Northern Ireland and the Republic of Ireland 1955-60 (cwt gutted)

Year	Total	England	Northern Ireland	Repbl. of Ireland
1955	171,347	69,226	70,179	31,942
1956	148,122	59,603	48,443	40,076
1957	173,609	64,397	60,016	49,196
1958	201,976	55,663	76,356	69,957
1959	217,017	56,374	94,073	66,570
1960	158,153	75,668	27,824	54,661

In addition to these quantities, considerable catches are taken by continental vessels. The published statistics of these countries do not distinguish landings in Region VIIA from those of Region VIIF. However, from the proportion of tags returned by continental vessels during English tagging experiments, it is estimated that the continental landings would not exceed 25% of the total given in Table 1[x].

Further small quantities of whiting are landed at English ports by foreign (including Irish) vessels and in 1960, for example, these amounted to a further 5,816 cwt, some 3% of the total shown.

The relative importance of whiting in the total catch of demersal species is shown by the comparison of the average landings of principal species by England and Northern Ireland 1956-60 (Table 2).

Table 2 The average species composition of total demersal landings from the Irish Sea by England and Northern Ireland 1956-60 (cwt gutted)

		Whiting	Cod	Haddock	Hake	Sole	Plaice	Skate/Ray	Total
England	cwt	62,341	37,197	9,158	5,589	11,736	29,160	49,600	232,706
	%	26.8	16.0	3.9	2.4	5.0	12.5	21.3	
N. Ireland	cwt	61,342	7,984	3,233	1,299	10	1,770	572	82,109
	%	74.7	9.7	3.9	1.6	-	2.2	0.7	

During the period 1956-60 the average yield of whiting was approximately the same in both countries yet in Northern Ireland this comprised 74.7% of total demersal landings in contrast to 26.8% of English landings. Clearly sole, plaice and skates and rays support fisheries accessible to English fishermen which provide only a negligible proportion of Northern Irish landings. This difference may be attributable to the composition of the two fishing fleets: English fishermen exploit the various demersal stocks according to the seasonal pattern of abundance of the different species and do not have a 'single species' fishery comparable to the Irish whiting fishery. By contrast Northern Irish fishermen have 'general purpose' vessels capable of exploiting other 'single species' fisheries for herring and Nephrops when whiting are not available.

This seasonal dependence upon whiting of Northern Irish fishermen is illustrated by Figure 1 showing the proportion of the total value of all catches contributed by whiting, herring and Nephrops. Between October and March whiting provide 51% of the total revenue, rising to over 60% in November and December.

Geographic Distribution of the Fisheries

The locations of the principal seasonal whiting fisheries are shown in the sketch map (Figure 2) with their contribution to the total catch of whiting in Table 3.

Table 3 The contribution of catches from the seasonal fisheries to the total whiting catch, 1958-60

	Area - I & II				IV	V	VI		
Quarter	England	N.Ireland	Rep.Ireland	Total	England	England	England	Elsewhere	Total
1-3/58	2,896	16,501	8,134	27,531	3,290	1,699	3,113		
4-6/58	2,328	4,991	3,564	10,883	5,659	2,295	2,984		
7-9/58	1,467	957	7,855	10,279	588	10,257	933		
10-12/58	9,516	53,613	43,504	106,633	2,665	1,383	507		
Total (%)				155,326 (76.9)	12,202 (6.1)	15,634 (7.7)	7,537 (3.7)	11,277 (5.6)	201,976
1-3/59	1,301	20,195	8,875	30,371	2,765	2,241	1,976		
4-6/59	1,001	2,426	2,079	5,506	2,472	8,484	1,850		
7-9/59	811	11,936	18,781	31,528	606	9,940	753		
10-12/59	2,096	59,514	29,735	91,345	1,625	14,320	534		
Total (%)				158,750 (73.2)	7,468 (3.4)	34,985 (16.1)	5,113 (2.4)	10,701 (4.9)	217,017
1-3/60	897	7,272	10,571	18,740	4,558	14,714	794		
4-6/60	184	701	3,001	3,886	5,689	10,715	3,289		
7-9/60	1,425	746	13,623	15,794	886	8,290	399		
10-12/60	4,118	19,105	27,266	50,489	2,494	11,901	817		
Total (%)				88,909 (56.2)	13,627 (8.6)	45,620 (28.8)	5,299 (3.4)	4,698 (3.0)	158,153

During August and September a fishery for whiting develops off Dublin in the vicinity of Rockabill and Lambay Island (Area I). These concentrations are fished by vessels from the Republic of Ireland which are joined by a proportion of the Northern Irish fleet of 'fly seiners' and trawlers as the herring season declines. During the final quarter of the year the fishery extends northward forming the main County Down fishery (Area II) which is exploited by Irish and Northern Irish vessels plus a small number of English, Scottish and continental trawlers. As the season progresses the fishery contracts northward and usually ends at the beginning of April near the northern entrance to the Irish Sea.

During these same months, but beginning slightly later, an analogous fishery develops in the Firth of Clyde (Area III) which is exploited by Scottish Danish seiners only. This fishery yielded 80,711 cwt in 1959 and 33,476 cwt in 1960.

During February and March the 'Conway' fishery occurs off the coast of North Wales (Area IV). This is fished by English trawlers and Danish seiners from Fleetwood and Conway in addition to foreign vessels, including larger Irish boats landing at Holyhead and Amlwch. The catches from the area amount to only 5% of the total yield but nevertheless they are extremely important to the smaller English fishermen who are heavily dependent upon these whiting populations before the Morecambe Bay plaice and sole fisheries come into season.

A similar fishery occurs in March and April off the south-east tip of Ireland (Area VI). English landings from the area represent 3% of the total for Region VIIA but these whiting stocks show a greater affinity to the whiting populations of Regions VIIF and VIIG so that this fraction is excluded from further considerations relating to Region VIIA.

East of the Isle of Man a whiting fishery persists throughout the year off Whitehaven (Area V). English landings from this region have recently increased from 25% of English landings in 1959 to some 50% in 1961 and in 1960, the last year for which full international statistics are available, this represented 28.8% of the total catch from Region VIIA. During the 1955-1959 period this fishery showed a remarkable increase in the abundance of whiting (Table 4) which cannot yet be placed in perspective since it may be partially attributable to increased efficiency of the fishing gear, or decreased rejection rates on English trawlers. Seasonal variations in abundance are not well marked in this area though catches tend to be least in the first quarter of the year.

Table 4 The abundance of whiting recorded off Whitehaven (Position V) by English motor trawlers (1955-1961)

	1955	1956	1957	1958	1959	1960	1961
Mean cwt/100 hrs	17.3	18.7	23.2	70.1	108.2	97.3	103.6
Cwt landed (all gears)	15,450	16,089	20,003	15,634	34,985	45,620	20,910

Position VII on the map indicates the estimated position of a spawning ground identified by the occurrence of pelagic whiting eggs in March and April. This ground is mostly unsuitable for bottom trawling but the general location appears to lie between the areas where both the County Down and Clyde seasonal fisheries cease.

These represent the principal seasonal fisheries but whiting are taken throughout the year as by-catch of vessels fishing predominantly for other species, and in other minor whiting fisheries, e.g., Solway Firth. Catches from these sources amount to less than 10% of the total recorded by England, Northern Ireland and the Republic of Ireland.

Length Composition

Representative percentage length frequency distributions from the principal seasonal whiting fisheries are illustrated in Figure 3.

Figure 3(1) shows the composition of the total catch taken by Northern Irish seiners using 52-55 mm mesh gear in February 1957. The proportion of this catch which is rejected to comply with the minimum landing size of 25 cm is also indicated by the hatching. This should be compared with the mean length composition of the

catches landed by the Northern Irish fleet in the 1958/59 - 1961/62 seasons (Figure 3(2)). This distribution is also typical of catches by vessels from the Republic of Ireland (where the minimum size is 24 cm) bearing in mind that the modal length of Northern Irish catches may be slightly higher owing to the growth of fish during the winter months.

Figures 3(3) and 3(4) represent the length distribution of English landings from the Conway and Whitehaven fisheries where 70 mm gear is used and a 25 cm minimum landing size is in operation. The modal length of landings at Conway lies at 30 cm in contrast to the 26 cm modal length of the County Down population. Comparisons between research vessel catches and commercial landings at Conway in 1960 confirmed that this is a real difference caused by the absence of small fish; it is not an artefact caused by the selection pattern of the larger mesh or different rejection rates on the English vessels.

These distributions should be compared with a single sample taken by a Milford Haven trawler in the vicinity of the County Down fishery in April 1957, after the seasonal fishery had finished (Figure 3(5)). The modal lengths recorded in the County Down and Conway fisheries are represented at 26 cm and 30 cm but the main proportion of the sample lies at lengths which scarcely appear in either of these fisheries. Distributions similar to this have been recorded from the area indicated by Area VII in the sketch map.

A typical distribution of Scottish landings from the Clyde fishery is also shown for comparison with that of the County Down fishery. These fishermen use 70 mm gear.

Data are not available from the landings of continental vessels.

The County Down fishery is based on a population with a lower modal length than any other of the principal whiting fisheries of Region VIIA. It is this fishery which is exploited with gear that does not conform to the minimum mesh provisions of the 1946 Overfishing Convention and which may yield 70% of the whiting landed from Region VIIA, leaving aside the heavy rejection rate.

It is maintained that in this fishery the enforcement of 70 mm mesh gear would result in a large loss during a period of the year when the fishermen are almost entirely dependent upon whiting, because the bulk of the population lies in the lower half of the selection range of 70 mm gear.

The long term effect of enforcing gear conforming to the Convention depends critically upon the recognition of the factors responsible for the very low modal length of the stock. Possible causes have been outlined by Beverton (1957); these are:-

(a) the effects of intensive exploitation with 52-55 mm gear;

(b) natural factors;

  (i) a progressive loss of larger fish by emigration;

  (ii) a regionally lower growth rate;

  (iii) a regionally high natural mortality rate.

If the observed length distributions of the County Down stock can be attributed to intensive fishing, then the use of 70 mm meshes might be expected to improve the yield by releasing a larger proportion of small whiting, i.e., those at present rejected, enabling them to grow larger before being captured. Alternatively, if the low modal length is caused by biological factors then the use of 70 mm meshes may give no appreciable long term benefit.

Research by the working group has therefore been centred on the determination of stock identity in order to establish the degree of emigration, if any, from the County Down stock, and the estimation of the effects of fishing upon it.

The Identity of Whiting Stocks within Region VIIA

1. Tagging Experiments

Three tagging experiments have been carried out in which 4,128 whiting, estimated to have survived the marking, have been released within the area of the County Down fishery. Of 1,244 fish that have been recaptured, 1,069 were caught within the County Down fishery and 77 from known positions in adjacent areas. The distribution of these recaptures is shown in Figure 4. Very small numbers have appeared off the west coast of Scotland and off south-east Ireland, but the largest proportion of recaptures from outside the tagging area has come from east of the Isle of Man, In Morecambe Bay. Five particularly long migrations should be noted, four to an area off north-west Cornwall and a fifth to the Brixham seasonal fishery.

The pattern of recapture to some extent reflects the distribution of fishing effort but clearly the number of whiting returned from within the marking areas was very much greater than the returns of whiting which had shown appreciable movement. However, detailed analysis of tag returns and fishing effort data has shown that the rate of recapture within the County Down area, and by English vessels in the Morecambe Bay area, is consistent with the emigration from the County Down fishery of some 40% of the tagged fish. These did not return to the County Down fishery in subsequent seasons.

Figure 5 shows the distribution of returns from other English experiments, excluding returns from within the marking areas. The total numbers of returns have not been sufficient to permit a detailed analysis but they serve to indicate the apparent mobility of the whiting stocks in Region VIIA.

2. Commercial Fishery Statistics

(i) Analysis of the age composition data for Region VIIA has shown the various seasonal fisheries to contain up to six age groups whose abundance can be estimated. The fishery off Dublin (Figure 2,I) is dependent upon one and two year old whiting with an additional concentration of 0-group whiting which are not liable to capture by commercial gear. These same age groups contribute to the main County Down fishery (Figure 2,II) with the addition of a higher proportion of adult fish of two, three and four years of age.

The abundance of 0, one and two year old whiting within Region VIIA but not included in the County Down fishery is not accurately known at present because they lie at lengths which are not fully recruited to the English fisheries east of the Isle of Man.

By contrast to the seasonal concentrations of 0, one and two year old whiting, the older age groups (3+) are uniformly distributed throughout the region lying between latitudes 53-55°N.

Assuming the unestimated proportion of 0, one and two year old whiting to have a relatively low density compared with that of the County Down fishery, the observations indicate that the County Down fishery is based upon juvenile whiting undergoing a part of the seasonal cycle with an additional proportion of adult whiting. Later in life these fish become more evenly distributed over the whole area.

(ii) The foregoing conclusion is supported by statistics from the 1960/61 County Down season. Total catches from this fishery in the fourth quarter of the years 1957-1960 were 78,615 cwt, 106,633 cwt, 91,345 cwt and 50,489 cwt respectively.

The 1960/61 season failed when whiting did not achieve their usual seasonal abundance in the County Down area, yet the overall density of whiting was not unusually low (see below).

		1957	1958	1959	1960
No/100 hrs fishing	(County Down	19,139	25,471	19,068	12,533
	(Mean Region VIIA 53-55°N	9,059	9,960	11,369	10,658

This failure was probably due to a biological factor which prevented whiting from moving to the seasonal fishery in their usual numbers rather than to an unusually low density of a separate unit stock.

(iii) Analysis of the fluctuations in abundance of whiting within single County Down seasons has shown that the seasonal decline in January-March is not closely related to fishing effort as would be expected if the low modal length of the stock resulted from excessive fishing alone. In 1958/59 fishing effort in this period was slightly higher than usual but the fishery declined less rapidly than in 1957/58 or 1959/60. This prolonged season was also detected in one of the English tagging experiments.

(iv) It has been noted that the Clyde whiting fishery has an age composition analogous to that of the County Down fishery despite a higher length distribution. Older records show that the Clyde population had a very similar length composition before the population was heavily exploited. This indicates that the present composition of the Clyde fishery, and by analogy the County Down population, cannot be attributed solely to fishing activity.

3. Parasite Studies

Dr. Kabata of the Marine Laboratory, Aberdeen, has studied the geographical distribution of gall bladder Protozoan parasites of whiting off the west coast of the United Kingdom. He has identified two principal genera, Ceratomyxa, which is prevalent north of latitude 55°N, and Myxidium, which predominates within the Irish Sea, south of this line. So far as it is known these two organisms are mutually tolerant and generate persistent infections. No other environmental barrier to their dispersion is known to exist so that we must suppose that very few whiting infected with Myxidium migrate north from the Irish Sea. These results have yet to be confirmed but it is legitimate to conclude that whiting fisheries off the west coast of Scotland are not heavily dependent upon Myxidium-infected (Irish Sea) whiting.

Of the remaining factors listed by Beverton as potential causes of the observed low modal length of the County Down population, the recognition of unique rates of growth or natural mortality are only diagnostic of the existence of a unit stock under special circumstances. For example, the presence of growth rates comparable to those of adjacent stocks may result from complete mixing with the County Down populations or the existence of two adjacent unit stocks with identical growth rates. Conversely, unusually slow growth only indicates the existence of a unit stock when it can be shown that preferential emigration of the faster growing fish does not occur. In fact the growth rate of County Down whiting is comparable with that of North Sea whiting but slower than that of Clyde whiting.

It has not been possible to form reliable estimates of regional natural mortality rates but there is no reason to suppose that this would be abnormal in the County Down fishery; the incidence of diseased fish is not unusually high and there are no unique stocks of major predators.

This summary of relevant data supports the conclusion that the seasonal whiting fisheries within the Irish Sea are not based upon independent unit stocks. The County Down fishery represents the principal seasonal aggregation of juvenile whiting which provides one (but not necessarily the only) reservoir of recruits to adjacent areas. Some interchange probably takes place northwards across the approximate line 55°N but the main recruitment is to the areas east of the Isle of Man and further south. There is no evidence to indicate the subsequent return of these fish to the County Down fishery although a few may remain there to provide the observed small numbers of adult whiting in the County Down catches.

The apparent seasonal decline of the County Down fishery and its low modal length are caused by a combination of emigration of whiting, the effect of fishing, and a change in the availability of the whiting remaining in the area.

The Effect of Fishing and Emigration upon the County Down Whiting Population

From the analysis of the age composition of the stock between 1957 and 1960 the coefficient of total mortality (Z) within the County Down population is estimated as Z = 1.4 (75%) for whiting of two years of age and above. (Indices of abundance of the younger age groups are unreliable). The distinction between fishing mortality (F) and natural losses (M'), i.e., the combined effects of natural mortality and emigration, within this total requires a degree of variation of fishing effort which has not occurred during the period for which data are available. Some indication of the relative magnitudes of these two parameters can be gained by comparing the effects of fishing upon this stock with the effects in adjacent stocks. Similar estimates of Z for the Morecambe Bay whiting population gave a value Z = 0.8. Fishing intensity in this area is one fifth of that obtaining in the County Down fishery so that the apparently high value of Z in both areas implies a high level of natural loss from both populations. In the absence of adequate data from a single population, the effects of fishing in these two areas have been combined to give a provisional distinction F = 0.9 and M' = 0.5 (Z = 1.4) for the County Down population.

Analysis of tagging data has shown that the fishing rate within the County Down fishery would account for 80% of a static whiting population during the six month season October-March. This is substantiated by 56% and 53% returns of cod tagged at the beginning of December 1957 and December 1958 respectively, and recaptured within the same area. Returns of whiting from this fishery by English, Northern Irish and vessels from the Republic of Ireland have been much less at 19.6% and 22.7% in the 1957/58 season, and 26.0% in 1958/59. Allowance is made for tagging mortality in this estimate which indicates the degree to which whiting are protected by their pattern of behaviour; fishing effort (i.e. fishing rate) remains high throughout the season but emigration from the stock during January-March reduces the proportion of the total stock exposed to the extensive exploitation.

Using estimates of the parameters of fishing mortality and natural loss estimated from the tagging experiments it can be shown that the most probable combination of values during the County Down season gives a total seasonal loss of Z = 1.9 (85%) equally divided between the effects of fishing and emigration. The effect of fishing upon the whiting within the County Down area at other times of the year is relatively insignificant (see Table 3) so that the annual level of fishing mortality is thought to be approximately F = 0.9 (60%).

The subsequent return of whiting in the following season reduces the initial loss (Z = 1.9) to a nett annual loss of Z = 1.4 estimated from age compositions. The loss by emigration and natural mortality would amount to M^1 = 0.5 (i.e. Z = $F+M^1$ $\therefore$ M^1 = 1.4 - 0.9). In assessing the effects of mesh regulation upon the yield from the County Down fishery the parameters expressing the population structure during the period 1957-1960 have therefore been taken as F = 0.9, M = 0.2 and E (emigration) = 0.3.

An Assessment of the Effects of Mesh Regulation within Region VIIA with particular reference to their Effect upon the County Down Fishery

(i) Long Term Effects

The assessment of fishery regulation by control of mesh size depends critically upon the selection characteristics of the gear in question. Selection data for whiting collated by the I.C.E.S. Comparative Fishing Committee give a mesh selection factor of 3.76 with a 'selection' range of 5 cm. There is no distinction between the selection factors of different types of gear but it should be noted that there have been relatively few determinations of the selection characteristics of seine nets and some distinction between the selection characteristics of trawls and seine nets is accepted. The data that were available for seine nets gave selection factors very slightly higher than for trawls but were not sufficiently numerous to permit a test to be made of the significance of the small difference.

Using these factors the principal long term effects of changes in mesh size between 52 mm and 70 mm have been assessed using the methods given by Beverton and Holt (1957).

From the data available it has been concluded that the County Down stock can be regarded as a seasonal aggregation of juvenile and newly mature whiting which become more uniformly distributed throughout Region VIIA as they grow older.

The long term effects of an increase in mesh size upon the present yield from this County Down stock can be assessed by setting up a series of hypotheses.

(i) The County Down whiting population may be regarded as a unit stock exploited with 52-55 mm gear in which all age groups are equally available to the gear.

(ii) The County Down population may be regarded as in hypothesis (i) with an additional loss of fish caused by emigration of whiting which are not subsequently exploited and thus may be regarded as a component of the natural mortality.

(iii) The County Down stock may be regarded as a stock which is exploited with 70 mm mesh gear both in the County Down area and elsewhere.

These hypotheses are represented by Curves A, B and C respectively in Figure 6 for a range of fishing mortality where the natural mortality is taken as $M = 0.2$ in Curves A and C, and as $M = 0.2 + 0.3$ (0.5) for Curve B.

The present yield obtained from the County Down fishery is indicated on Curve B. The true yield from the whole of Region VIIA would lie between Curves B and C since the population is exploited by 52 mm mesh gear within the County Down area, and 70 mm gear elsewhere. This level cannot be specified at present because the recorded yield from the areas not included in the County Down fishery contains a proportion of whiting recruited from local juvenile stocks which never contribute to the County Down stock.

A comparison of Curves A and C shows that the general use of 70 mm gear throughout Region VIIA would lead to a long term increase in yield even if there were a serious error in the estimate of emigration from the County Down seasonal fishery.

This conclusion must be qualified by two factors:

(i) emigrant whiting included under Curve C occupy a far wider habitat and do not form seasonal concentrations of the magnitude associated with the County Down fishery so that they would be less 'catchable'. This means that the amount of fishing effort required to generate a given fishing mortality on Curve C would be greater than on Curve B.

Consequently if the present level represents the upper limit of effort the effective fishing mortality would be less under the conditions relating to Curve C and the yield would tend towards its maximum.

(ii) Curve C is based upon the assumption that all fish originating from the County Down fishery should be available within Region VIIA. In fact, some further emigration is believed to occur especially to an area off south-east Ireland. Within Region VIIA itself there is some indication that older whiting move into deeper water where their abundance is not sufficient to provide the basis of a commercial fishery so that they are effectively lost (see Figure 3). These factors would tend to reduce the level of Curve C.

Taken over the whole of Region VIIA there would be a prospect of an increased yield if 70 mm mesh gear were in general use but the point has been made that these stocks would be more widely distributed. They would like partially beyond the range of Irish day boats and would not be available in comparable concentrations at the time of year that the Irish fishermen depend upon whiting.

In addition to the long term effects of a change in mesh size upon the yield from Region VIIA as a whole, the effect upon the catches from the County Down seasonal fishery alone must be considered. In this situation the potential yield from the exploitation of emigrant whiting can be disregarded and the yield from the County Down fishery alone assessed for different mesh sizes when $F = 0.9$, $M = 0.2$ and $E = 0.3$ - the estimate of basic parameters obtained by analysis of the present effects of fishing upon the stock.

The results of this analysis are outlined in Table V. With the present minimum landing size of 25 cm (effectively 24 cm) the landed catch would be increased by 8% with the use of 70 mm mesh gear although the total catch would have been reduced by 7%. As the mesh is increased the weight of fish that must be rejected to comply with a minimum landing size if reduced and a basic loss from the total catch may be offset to give a small gain in the landed catch.

Of the parameters upon which this analysis is based, the estimate of natural loss is the least reliable and may fluctuate from year to year. For example the length frequency distribution of the County Down population in February 1957 (the only available sample of total catch as opposed to landed catch) was more compatible with a value of total mortality $Z = 1.6$. Fishing effort in the County Down fishery has remained fairly constant so that the combination of parameters in this season could have been $F = 0.9$, $M' = 0.7$ ($Z = 1.6$). Using these values a change from 52 mm to 70 mm mesh would lead to a 5% decline of the landed catch with the present minimum landing size, instead of the small gain shown in Table V. Conversely, if the rate of emigration has been overestimated, or a proportion of the emigrant whiting return in subsequent seasons then the gain by using 70 mm gear will be slightly greater.

It is clear from these considerations that with the present minimum landing size, the enforcement of 70 mm mesh gear within the County Down fishery may lead to a long term change of $\pm$ 10%. The precise change cannot be specified owing to variation of emigration from season to season. At the same time the use of 70 mm gear would increase recruitment to adjacent areas from the County Down by 40%, but the potential increase in total yield from Region VIIA cannot be assessed until we have further information on other sources of recruitment to these adjacent stocks.

The Immediate Effect upon Catches from the County Down Fishery of a Change in Mesh Size

The whiting population of the County Down fishery contains a very high proportion of I-group whiting which are liable to capture by 52 mm gear although they do not contribute so highly to the landed catch owing to the rejection rate. This factor varies with the characteristics of the market and the rate of growth of the juvenile fish. Fluctuations of the environment may lead to variations of 2 cm in the mean length of I-group fish recruiting to the County Down fishery so that the immediate change in yield to be expected from a change of mesh size is extremely sensitive to the growth of one particular year-class.

The relative yields by weight expected from different mesh nets in years of average growth are shown in Figure 7 and Table VI. At the present minimum landing size of 25 cm the immediate loss would be 25%. This loss would be less at intermediate mesh sizes, as shown by the illustration.

It should be noted that throughout this discussion it has been assumed that catches landed by Northern Irish fishermen are represented by the length frequency distributions of the marketed fish. In some years a proportion of the catch referred to above as 'rejects', i.e., less than 25 cm length, has been landed. If this component is taken into account the losses caused by the use of 70 mm gear would be increased. For example, if the entire catch of 52 mm gear were compared with that of 70 mm gear, the loss would amount to 38%.

The fact that fish caught at lengths below the minimum size are sufficiently numerous to be landed indicates that the minimum landing size bears no relation to current fishing practice; rejection may amount to 20% by weight of the total catch. Tagging experiments have shown that the survival of whiting actually rejected at sea will be negligible so that it is of particular importance that the minimum landing size should be adjusted to support the mesh regulation: the present level is suitable when 70 mm gear is in use but could be reduced if smaller meshes are permitted.

The Effect of Fishing with Small Meshed Nets upon other Protected Species

Table 2 of the annual catch of different species shows clearly that Northern Irish fishermen have no significant fishery for plaice and sole. Small quantities of other protected species, cod, haddock and hake are taken, but the mean length of catches shows that these stocks would also be liable to capture in 70 mm gear. There are no other stocks of juvenile protected species within the area of the County Down fishery. The present use of 52 mm gear therefore has no influence upon the abundance of adjacent stocks of protected species and no improvement would accrue from the enforcement of 70 mm gear.

Summary

1. Fishermen of Northern Ireland and the Republic of Ireland are heavily dependent upon whiting catches from the County Down fishery during the winter months October-March.

2. The whiting population within this fishery constitutes a seasonal aggregation of juveniles, with a small proportion of adults, which provides recruits to adjacent whiting fisheries as the fish grow older.

3. The enforcement of 70 mm gear within this area would give an overall increase in yield of whiting from Region VIIA.

4. The extent of this gain cannot yet be assessed owing to uncertainty regarding the magnitude of stocks of juvenile whiting outside the County Down area but emigration from the County Down stock would be increased by 40%.

5. The increased stock abundance would not be available to Irish fishermen owing to changes in the distribution of the older whiting upon which the stock would be based. The population would need to be fished at other times of the year at greater distances beyond the range of Irish day boats. The gains referred to would be taken primarily by English and continental vessels.

6. Within the County Down fishery itself, enforcement of the minimum mesh provision of the 1946 Convention (70 mm) would in the long term result in a change of + 10% by weight in the landed catch controlled by 25 cm minimum landing size. The change cannot be specified with any greater accuracy owing to annual fluctuations in the fishery.

7. The enforcement of 70 mm gear within the County Down fishery would cause an immediate decline of some 30% in the landed catch. This would be less in years of good growth of the recruit year-class.

8. The fishery would re-stabilise at the level expected by the long term change within five years.

9. The present use of 52 mm mesh has no effect upon adjacent stocks of other protected species. These would not benefit from the use of 70 mm gear.

References

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Beverton, R.J.H. & Holt, S.J. 1957 "On the Dynamics of Exploited Fish Populations" Fish. Invest., Ser. II, Vol. XIX.

I.C.E.S. "Report of the Mesh Selection Working Group". (in press)

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Table 5 The long term effects on yield of change in mesh size in the County Down fishery (F = 0.9, M = 0.5)

A) Index of yield per recruit

Mesh Size (mm)		52	60	65	70	75	80
Total Catch		575.1	560.6	551.5	535.6	502.6	480.4
	22 cm	547.7	545.8	543.1	531.4	511.1	480.4
Rejection	24 cm	469.9	491.9	504.9	509.5	502.6	480.2
	26 cm	351.4	394.1	426.9	455.0	476.9	478.7

B) Percentage change relative to present yield with 52-55 mm mesh.

Total Catch		100.0	97.4	95.8	93.1	87.4	83.5
	22 cm	100.0	99.7	99.2	97.0	93.3	87.7
Rejection	24 cm	100.0	104.7	107.4	108.4	107.0	102.2
	26 cm	100.0	112.1	121.1	129.5	135.7	136.2

Table 6 The Immediate Effects of Changes in Mesh Size in the County Down Fishery

A) Index of yield per recruit

Mesh Size (mm)		52	60	65	70	75	80
Total Catch		575.1	495.8	433.0	360.3	286.7	217.9
	22 cm	547.7	481.4	425.2	356.4	285.1	217.4
Rejection	24 cm	469.9	429.9	390.2	337.0	275.4	213.6
	26 cm	351.4	337.1	319.5	289.4	247.7	204.7

B) Percentage change relative to present yield with 52-55 mm mesh gear.

Total Catch		100.0	86.2	75.3	62.6	49.9	37.9
	22 cm	100.0	87.9	77.6	65.1	52.1	39.7
Rejection	24 cm	100.0	91.5	83.0	71.7	58.6	46.5
	26 cm	100.0	95.9	90.9	82.3	70.5	57.1

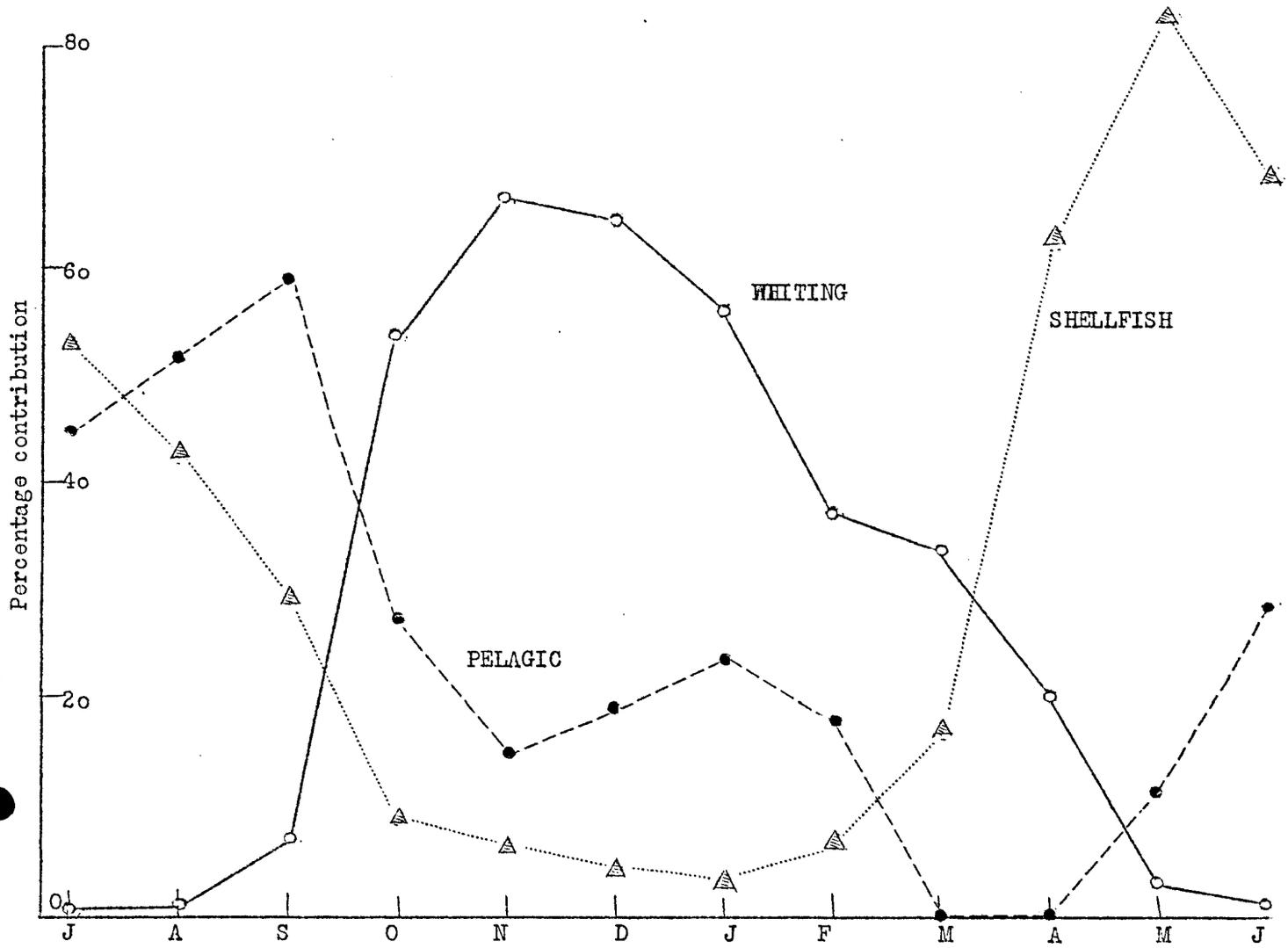

Figure 1. Seasonal variations in value of principal types as a percentage of the total revenu from all landings on the east coast of Northern Ireland (1958-1961).

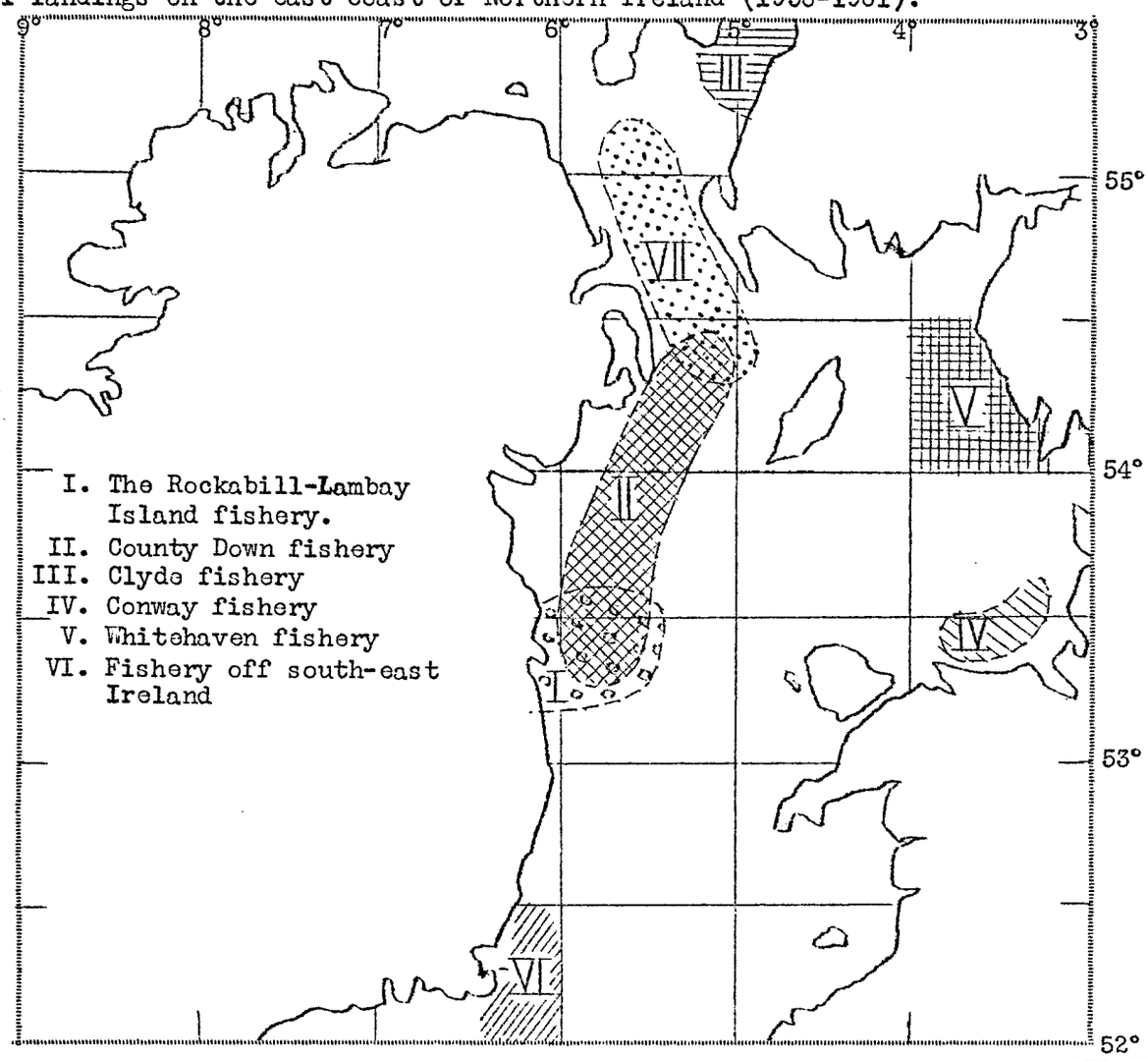

Figure 2. Sketch map showing the location of the [illegible]

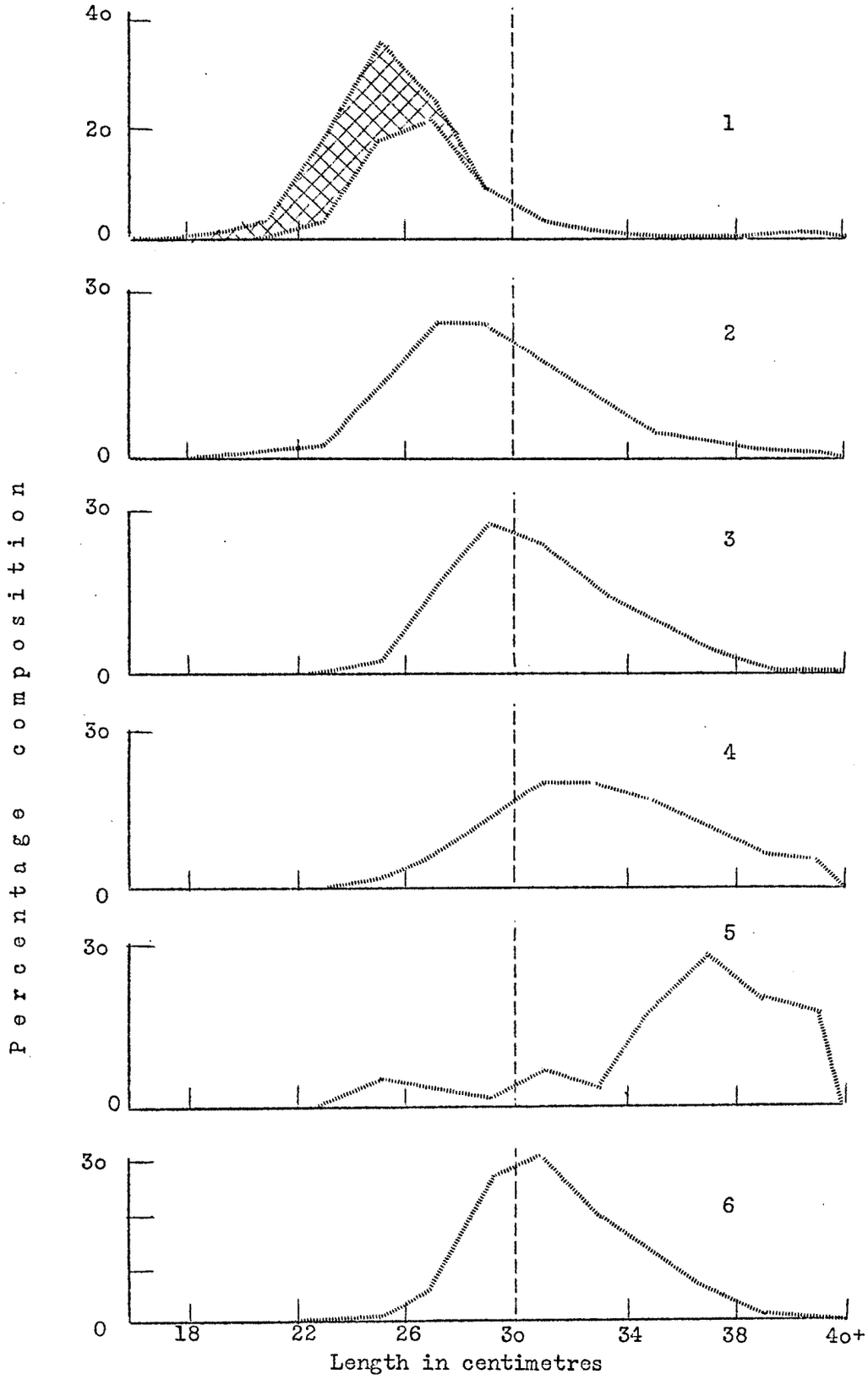

Figure 3. Length frequency distribution from seasonal whiting fisheries in Region VIIA.

(1) Total and landed catch by a Northern Irish seiner, February 1957.

(2) Landed catch by Northern Irish seiners 1958/59-1961/62.

(3) Landed catch from the Conway fishery. English trawl, 1957-196o.

(4) Landed catch from Whitehaven area (Rect. 7A).English motor trawler, 1958-196o.

(5) Landed catch from Rectangle YY6. Milford Haven trawler, April 1957.

(6) Landed catch from Clyde fishery. Scottish seine net, February 1959.

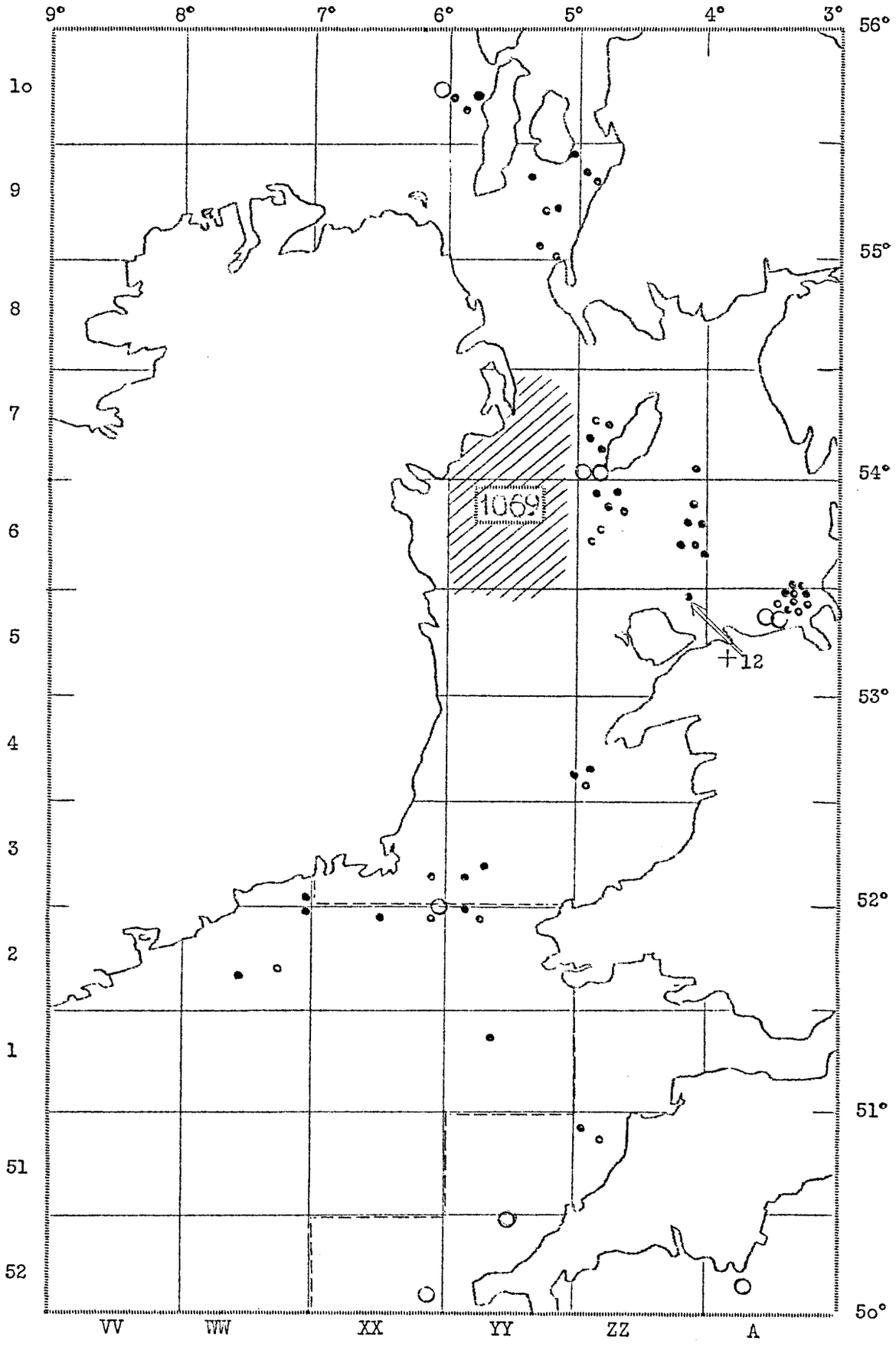

Figure 4. The distribution of returns from marking experiments within the area of the County Down fishery.

Release area

Returns from 1957/58 experiments

Returns from 1958/59 experiments

Each point represents single fish unless otherwise

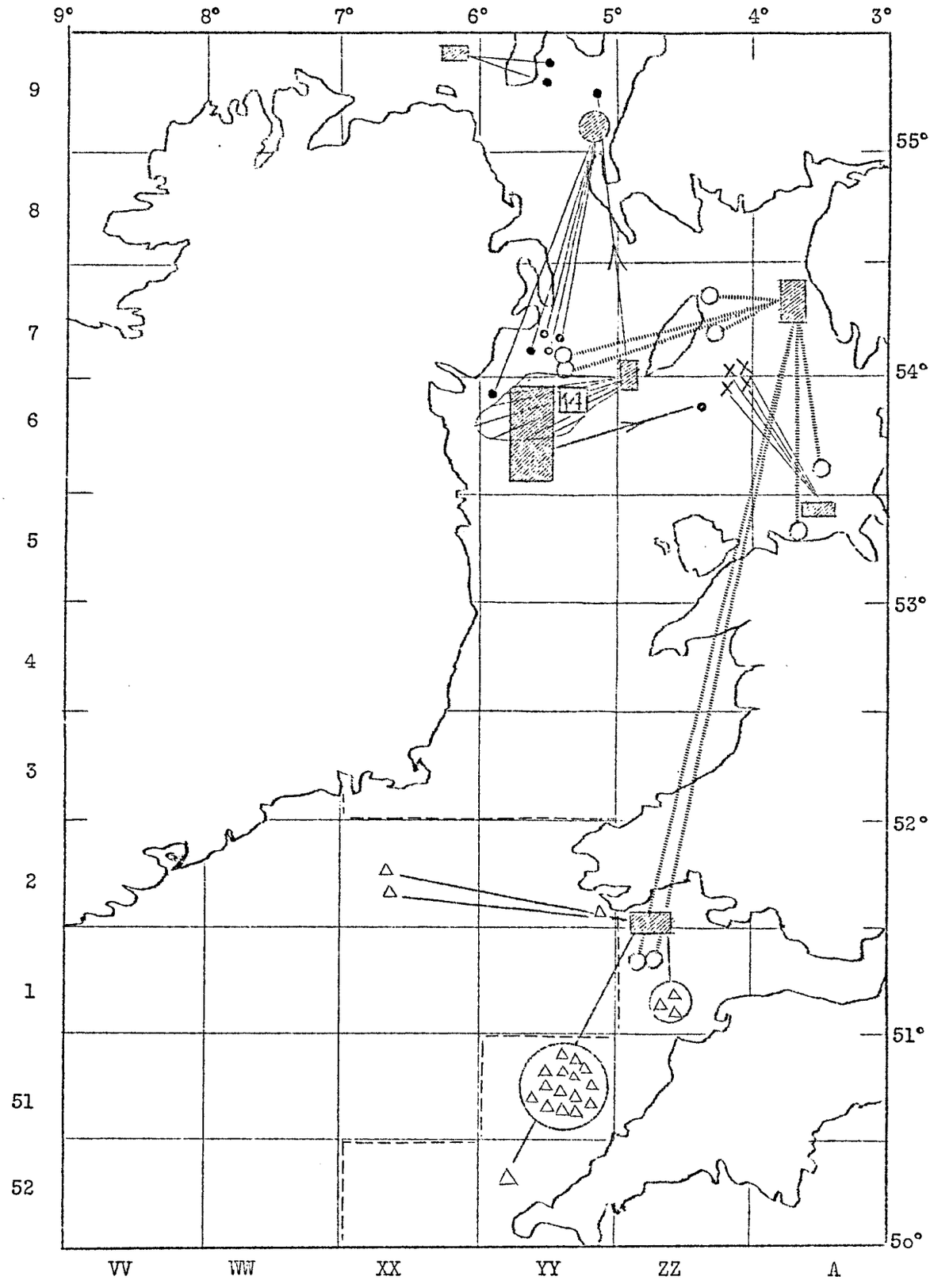

Figure 5. The distribution of returns from marking experiments within the Irish Sea but outside the area of the County Down fishery.

Release areas

The points indicate single recaptures from different experiments except:-

(i) Returns in the area of the County Down fishery from the release point off the south-west tip of the Isle of Man. The total number recaptured is indicated.

(ii) Returns from the same general area of the Trevose fishery in the Bristol Channel are encircled, the number of recaptures being indicated by individual points.

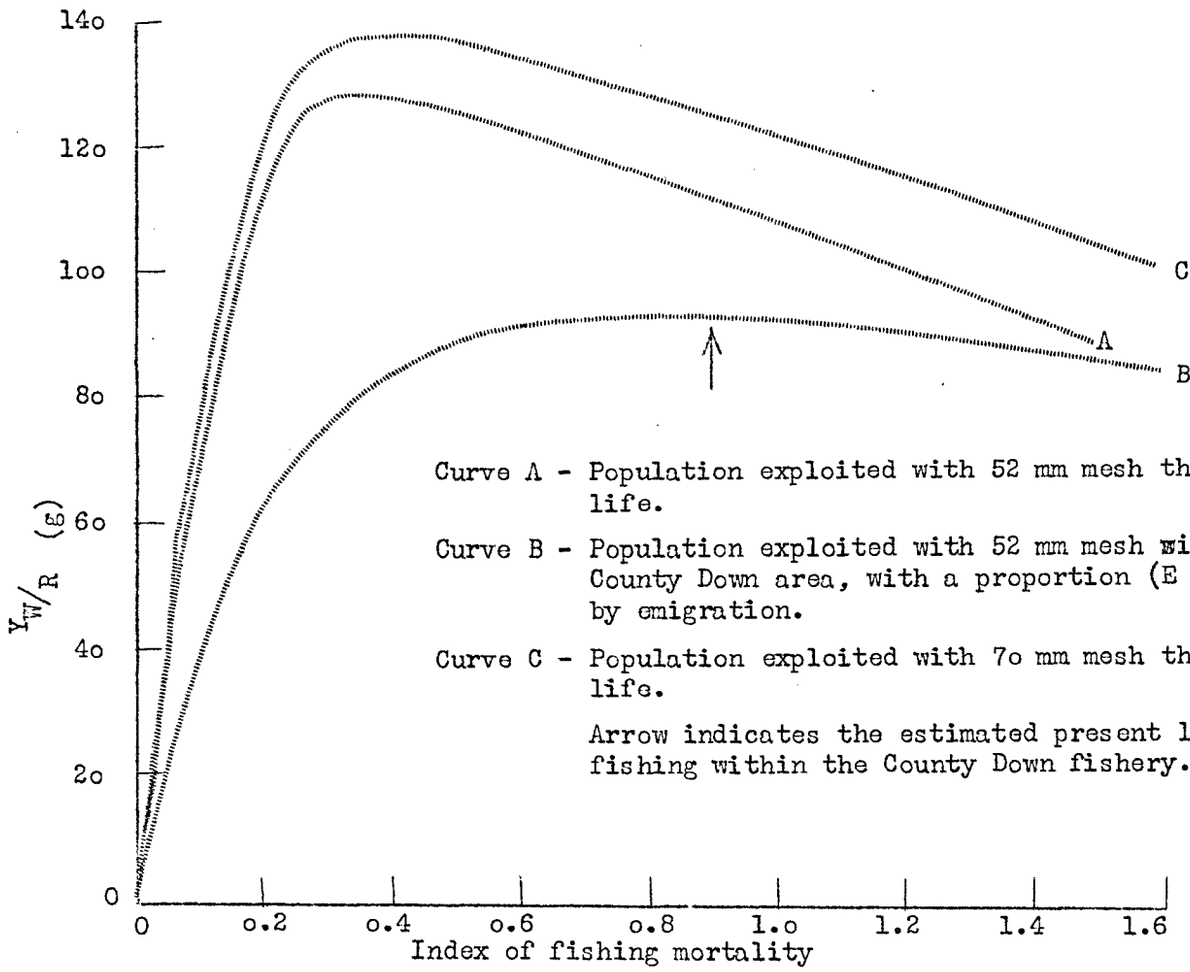

Figure 6. The yield per recruit of whiting under three situations of exploitation.

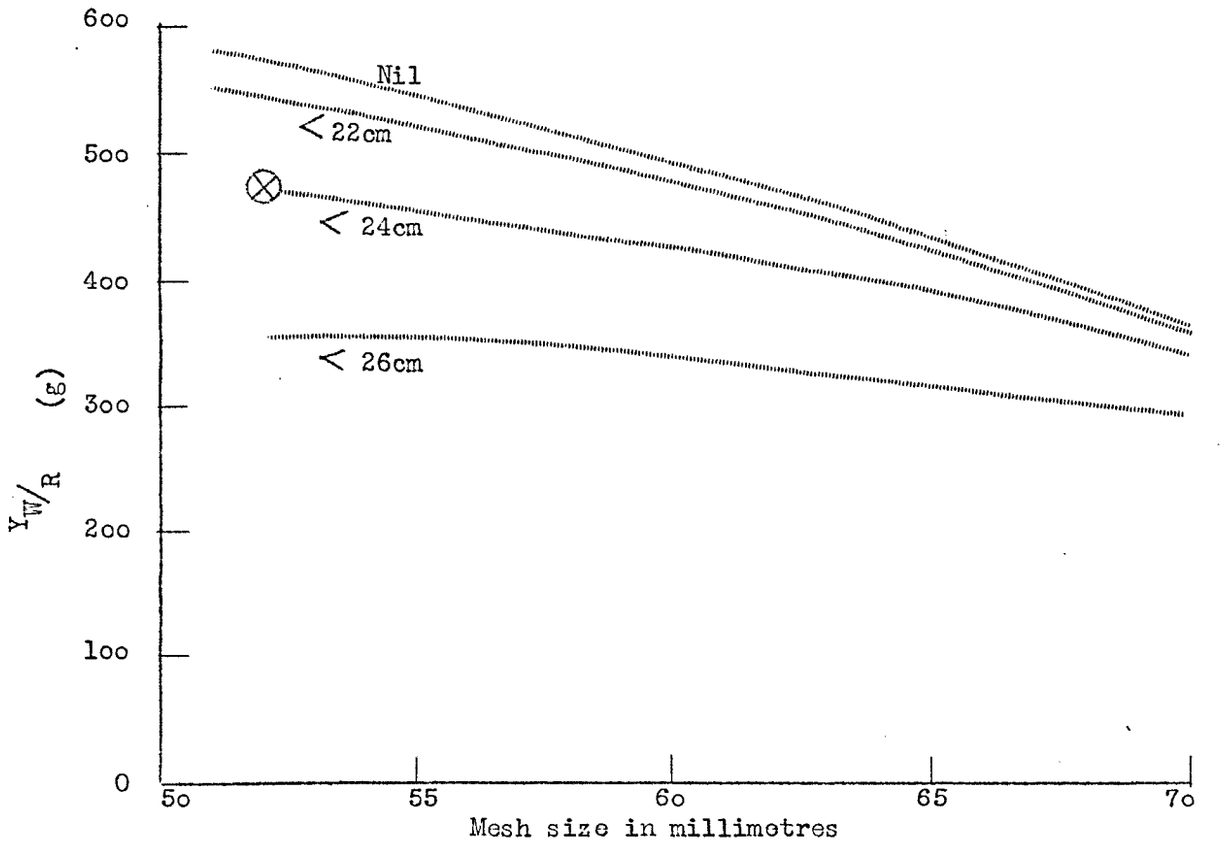

Figure 7. The immediate loss with increased mesh size at different minimum landing sizes.

⊗ Current fishing practice within the County Down fishery.