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Contents

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A. REVIEW OF NOMINAL CATCHES IN NEAFC AREA. 1962-68

1. From time to time, data on changes in the yields of one or more species in the Convention Area have been presented in the Committee's reports, in relation to assessments of the state of particular fisheries, but no general review of fish production in the Convention Area has previously been given, as a guide to the Commission. Such information, based on statistics published in the ICES Bulletin Statistique, is summarised in Tables 1-3, which give, for each NEAFC Region in the years 1962-68, the nominal catches of all species combined, demersal species (comprising the Pleuronectiformes - flatfishes, Gadiformes - cod-fishes, demersal Percomorphs - redfishes, gurnards, sandeels etc.), pelagic species (all species not included in the demersal fish group) and of each of the main species within the demersal and pelagic fish groups. Freshwater species, shellfish and the catches by non-member countries are not included in the Tables.

2. The main features of the fish production changes in each Region, revealed by these statistics are summarised below:-

Region 1 (Table 1)

3. The total production of all species combined was fairly steady from 1962 to 1964, being about 3.5 million metric tons. Thereafter it increased, reaching over 4 million tons in 1966 and 1967. It decreased again to 3.7 million tons in 1968. The increase in 1966 and 1967 was due mainly to a substantial rise in the catches of herring and capelin in Sub-areas I and II. However, while the capelin catch increased further to over 0.5 million tons in 1968, that of herring decreased greatly to 0.7 million tons. The catch of cod in Sub-areas I and II decreased from a level about 0.8 million tons in 1963 to about 0.5 million tons in 1964-1966, but it increased again thereafter to 1.1 million tons in 1968.

4. The herring catch in Sub-area V fluctuated around half a million tons in the years 1962-1966, but then decreased markedly to less than 40 thousand tons in 1968.

Region 2 (Table 2)

5. The total catch of all species increased continuously from 1962 to 1968 at an almost constant rate of 0.3 million tons per year. In this time the yield doubled, reaching 4.3 million tons in 1968, thus for the first time exceeding that from Region 1.

6. The increase during the most recent years can be attributed mainly to the fisheries for mackerel, cod and Norway pout in the North Sea and the Skagerrak. In 1968 these three species constituted more than 45% of the total catch from Region 2, compared with 14% in 1964. The cod catch increased progressively during the 1960s; the mackerel catch increased markedly after 1964, and the catches of Norway pout increased greatly after 1966 to become in 1968 the third most important fishery in Region 2, according to the statistics. The herring catch in the North Sea and Skagerrak increased from 0.8 million tons in 1961 to 1.5 million tons in 1965; it then decreased to a level around 1.1 million tons in 1966-68, when it constituted about 30% of the total quantity of fish landed from the North Sea and the Skagerrak. Catches of haddock, whiting, sandeels and flatfishes were higher during the second part of the period. Total catches in Subareas VI and VII (west of the British Isles) also increased steadily during the period; the herring catch increased from 100 thousand tons in 1962-65 to 142 thousand tons in 1968, and the cod catch increased steadily to 45 thousand tons in 1968.

Region 3 (Table 3)

7. Owing to inadequacies in the statistics for some countries the figures in Table 3 are given only as an indication of the main changes in fish production in Region 3. It would be unwise to attempt an interpretation of the apparent trends from these. The main inadequacy concerns the breakdown of the catches according to their origin. In fact, a substantial but unknown part of the reported catches did not come from Region 3 but from the southern part of Region 2 or even from areas outside the NEAFC area.

8. Given this qualification, the published statistics indicate that the total catch in this Region has fluctuated around 0.8 million tons in the period 1961-1967. It and the mackerel fishery has increased from 18 to 56 thousand tons over the last six years.

B. REGION 1 FISHERIES

B.1 NORTH-EAST ARCTIC FISHERIES (Annex I)

9. In the Committee's reports to the Commission in 1968 and 1969 the results of assessments of the state of the cod and haddock stocks in the north-east Arctic were presented. These indicated that the stocks of both species are heavily exploited and have been severely reduced by the high intensity of fishing on them,

especially on the cod, and that the maintenance of this high level of fishing intensity will result in further stock depletion in the future, and a consequent marked decrease in total catch and catch-per-unit-effort. Indeed, it was pointed out that the year-classes of both species which will recruit to the exploited stock in the next few years are weak, which, together with the high intensity of fishing on the fully recruited ones will lead to a marked reduction in spawning stock size by the mid-1970s, which would increase the dangers of the average level of recruitment to the exploited stock remaining at a low level. It was emphasised that effective regulations reducing fishing mortality rate now would lessen the dangers of these serious consequences.

10. In addition to these assessments, in the 1969 Report estimates were given of the total catches of cod and haddock that would be taken in 1970 and 1971, for various levels of fishing mortality rate which might form the basis of a catch quota regulation for these fisheries, should the Commission decide to introduce it. These estimates were based on catch and fishing effort statistics and other scientific data available in the years up to and including 1967.

11. Since the last meeting further assessments have been made of the expected catches in 1970 and 1971 in the light of data for the fishery in 1968 and provisional information on the catches taken in 1969; attention was paid especially to re-assessing the expected catches in 1970 and 1971, for different levels of fishing mortality rate. Despite high catches of both cod and haddock in 1968 and 1969, the results of these new assessments, which are set out in the Report of the Working Group, appended as Annex I, provide no grounds for modifying the conclusions drawn previously regarding the state of the exploited stocks, and the expected future decrease in catch and catch-per-unit-effort. These results are summarised below.

Cod

12. In the previous assessment, based on data up to 1967 it was assumed that in 1968, the effective fishing intensity and hence fishing mortality rate would increase by 10 per cent and that the cod catch would increase by 40 per cent from the 1967 level (following recruitment of the strong 1963 and 1964 year-classes). In fact, the statistics for 1968 show that the catch increased by much more than this, to over a million tons, which was 90 per cent greater than in 1967. The latest analysis shows that this was due to a much larger increase in fishing

intensity than had been predicted, the level in 1968 being about 40 per cent higher than in 1967, instead of the predicted 10 per cent. On the other hand the estimate of stock abundance, based on the available estimates of mortality rates, growth and recruitment was in accordance with expectation, thus indicating that there was no reason for modifying the values of the natural population parameters (especially of recruitment) used in the assessment.

13. The much higher fishing intensity in 1968 and 1969 than had been predicted did, however, necessitate a recalculation of the expected catches in 1970 and 1971, due to the effect on stock abundance of the higher fishing mortality in that year than had been used in the previous assessment. For this recalculation the fishing mortality rate on the fully recruited age-groups in 1968 was estimated to be F = 1.12 (the rate in 1967 plus 40 per cent), and for 1969 it was taken to be between the 1968 level and a higher one of 1.26 (the rate in 1967 plus 60 per cent), the latter being the estimated level required on the basis of the available data for the stock to give the catch approaching 1 million tons indicated for 1969 by the provisional statistics. Using each of these two levels of fishing mortality rate in 1969, estimates of the catches in 1970 and 1971 were then made for the following fishing mortality rates (F) in these years:-

a) F in both years being at the 1968 level;

b) F in 1970 at the 1968 level and in 1971 at the 1967 level;

c) F in 1970 at the 1968 level and in 1971 at a lower level (F = 0.53) corresponding with the maximum yield per recruit;

d) F in both years, at the 1967 level;

e) F in 1970 being at the 1967 level and in 1971 at the level corresponding with maximum yield per recruit (= 0.53);

f) F in both years being at the level corresponding with the maximum yield per recruit (= 0.53).

These estimates of catch are given in the following Table:-

Estimates of total catches (in 000's metric tons) from the north-east Arctic cod fishery in 1970 and 1971 at different levels of fishing mortality rate.

	F in 1969 at the 1968 level (1967 level + 40%)		F in 1969 at higher level than in 1968 (1967 level + 60%)	
	1970	1971	1970	1971
F at 1968 level in both years	526	313	483	290
F at 1968 level in 1970 and at 1967 level in 1971	526	245	483	227
F at 1968 level in 1970 and at level of maximum yield per recruit in 1971	526	174	483	161
F at 1967 level in both years	411	239	377	271
F at 1967 level in 1970 and at level of maximum yield per recruit in 1971	411	208	377	192
F at level of maximum yield per recruit in both years	291	244	267	225

14. The figures for 1971 represent the best estimates which can be made of the catch quotas which would need to be set if a catch quota regulation was introduced in that year to achieve a fishing mortality rate at one of the above levels. Inevitably the estimated catch for 1971 would be governed by the fishing mortality rate generated in 1970, which cannot be predicted accurately in advance. In the absence of more accurate data than is currently available on the total catch, fishing effort and stock composition in 1969, it is not possible to present more accurate estimates of the catches at each fishing mortality rate than the ranges tabulated above.

15. No estimates have been made of the catches that would be expected at a lower level of fishing mortality rate than that corresponding to the maximum yield per recruit (F = 0.53), but as indicated in last year's report it is still considered that a reduction to below this level would increase the probability of improved recruitment to the exploited stock.

16. It should be noted that these estimates do not include catches of coastal cod, for reasons given in Annex I.

Haddock

17. As with cod the nominal catches of haddock in 1968 and 1969 were very much higher than those expected on the basis of the assessment made last year. This was due mainly to the stock abundance being higher than that predicted from the values of the stock parameters then available; in particular, the strengths of successive year-classes in the stock were higher than had been estimated previously. Revised estimates of the expected catches in 1970 and 1971 were therefore made from the latest data on the stock parameters and on the assumption that the fishing mortality rate in 1969 was the same as in 1968, for the following levels of fishing mortality rate (F) in the two years:-

a) F at the 1968 level in both years;

b) F at the 1968 level in 1970 and at the 1967 level in 1971;

c) F at the 1968 level in 1970 and at the level (F = 0.30) corresponding with the maximum yield per recruit in 1971;

d) F at the 1967 level in both years;

e) F at the 1967 level in 1970 and at the level corresponding with the maximum yield per recruit (= 0.30) in 1971;

f) F at the level of the maximum yield per recruit (= 0.30) in both years.

These estimated catches are tabulated below.

Estimates of total catches (000's metric tons) from the north-east Arctic haddock fishery in 1970 and 1971 at different levels of fishing mortality rate.

	1970	1971
F at 1968 level (= 0.80) in both years	100	74
F at 1968 level (= 0.80) in 1970 and at ~~1970~~ 1967 level (= 0.60) in 1971	100	59
F at 1968 level (= 0.80) in 1970 and at level of maximum yield per recruit (= 0.30) in 1971	100	33
F at 1967 level (= 0.60) in both years	81	68
F at 1967 level (= 0.60) in 1970 and at level of maximum yield per recruit (= 0.30) in ~~both years~~ 1971	81	38
F at level of maximum yield per recruit in both years	45	48

18. Again, as with cod, the figures for 1971 represent the best estimates which can be made of the catch quotas which would need to be set in that year to achieve a fishing mortality rate at one of these levels of fishing mortality rate. It has to be noted also that in 1971 the differences between the catches at low levels of fishing mortality rate may lie within the margin of accuracy of the national statistical reporting systems.

19. The Committee wishes to point out that in using the present methods of assessment the main factors limiting the accuracy of estimating the catches for the commencement of a catch-quota regulation are:-

a) The absence of data on the population parameters and especially of the fishing mortality rate in the one or two years immediately preceding the introduction of the quota.

b) Errors in the use of the relative strengths of year-classes in the pre-recruit phase as a basis for estimating the absolute level of recruitment.

20. These factors prevent any specification of the confidence limits of the catch estimates given. It is recognised that errors in the estimates of catches of north-east Arctic cod and haddock three or more years in advance could be large. However, given reliable measures of the fishing mortality rate in the preceding year, the population data currently available are such that the error in estimating the catch at a given fishing mortality rate in the following year is likely to be low.

B.2 ICELAND COD RESEARCH PROGRAMME

21. In last year's Report to the Commission the Committee outlined the plans drawn up by ICES for further research on the cod stocks at Iceland, in relation to the proposal to close to trawling an area off the north-east coast of Iceland. Progress in this programme of work was reviewed at the 1969 ICES Meeting, with special reference to the following research projects:-

1. Stock identification studies, using serological and biochemical techniques.

2. Trawling and echo-surveys for investigation of the distribution and abundance of cod in the Iceland area.

3. Mesh-selection studies.

22. This programme will be continued in 1970 with the addition of 0-group surveys and special tagging experiments.

23. As requested by the Commission a report on the results of this research will be prepared for the Commission's meeting in 1971.

B.4 ASSESSMENT OF ATLANTO-SCANDIAN HERRING FISHERY

36. Following the general concern expressed at the Commission's meeting in 1968 about the state of the Atlanto-Scandian herring fisheries and stocks an ICES Working Group made an assessment of the present state of the herring stocks and fisheries up to and including 1968. This assessment concentrated mainly on the Norwegian spring-spawning component, which was the major stock within the Atlanto-Scandian herring tribe (see ICES Coop Res. Rep. Ser. B.1965) in the period concerned, but some consideration was given to the state of the Icelandic spring- and summer-spawning stocks.

37. The results of these assessments are set out in the report of the Working Party published as Coop Res. Rep. Ser. A. No. 17 1970 which has been circulated to Commissioners. They are summarised below.

Norwegian Spring Spawners

a) Adult Herring Stock and Fishery

38. Fisheries on adult Norwegian spring spawners in the years 1950-68 experienced two periods of high landings (over 1 million tons), from 1954-1957 and 1964-1967 respectively. In these periods the very large 1950 year-class and the 1959-60 year-classes respectively entered the fishery. The last period (1964-67) during which the highest annual catch ever recorded was made (1.7 million tons), was followed by a sharp decline in the landings, to about 250,000 tons in 1968, representing the lowest catch since 1925. Provisional information indicates that the 1969 catches were no higher, and probably lower than those in 1968. No large year-classes entered the adult stock since the 1960 year-class.

39. Estimates of fishing effort on the adult herring, made from catch-per-unit-effort data from the USSR drift-net fleet and the total catches, indicated an increase of about 30-80%, between the periods 1958-62 and 1963-67. However, the latest data available suggest a large decrease in 1968.

40. Estimates of adult stock size for the years 1953-1968, obtained by two independent methods, showed a reduction of the adult stock from about 14 million tons in 1955-56 to about 2 million tons in 1968. Although, in general, the fluctuations in the landings followed those in stock size, the data strongly suggest an increased rate of exploitation as the landings constituted an increasing

proportion of the adult stock. These, and mortality rate estimates obtained from abundance estimates of age-groups indicate that the rate of exploitation in the 1960s was at least twice as high as in the 1950s, with the highest exploitation rate in the years 1966-67, when the fishing mortality was probably at a level of 0.4-0.5.

b) Immature Herring Stock and Fishery

41. Landings of small immature herring (0+I group), which are caught mainly in coastal regions in northern Norway, have tended to decline since 1960. This decline was largely due to the low abundance of the small herring owing to a series of weak or moderate year-classes since 1960. The exploitation rate of each year-class was found to be related to year-class strength, being greatest for the weaker year-classes due to their having a more coastal distribution.

42. Landings of larger (older) immature herring (I-IV group = fat herring) increased sharply in the years 1967-68, after a slow rise in the landings in the period 1950-1966. The rate of exploitation in 1967-68, when the fishery was concentrated mainly on the moderate 1963 and 1964 year-classes, was found to be 5-6 times as high as in the preceding years. As natural mortality is probably relatively low in these large immature herring, it is expected that the increased fishery on them will have significantly reduced recruitment of the 1963 and 1964 year-classes to the adult stock.

43. In addition to changes in fishing rate on both the adult and the immature herring major changes occurred in the pattern of distribution, spawning grounds and migration of the Norwegian spring spawners, which may have affected the yields of the fisheries in recent years.

44. From the data available, it is concluded that the present poor state of the stock and catches of Norwegian spring spawners can be attributed to a combination of the following factors:-

a) the failure of recruitment to the adult stock since the entrance of the strong 1959-60 year-classes;

b) the abnormal migration pattern of the adult stock;

c) the increased rate of exploitation of the adult stock and, more recently, of the larger, immature herring (fat herring).

45. The increased rate of exploitation of the stock, both in the immature and

adult phase, has reduced the size of the adult stock. To a stock such as the Norwegian spring-spawning herring which, under normal conditions experiences sustained periods of poor recruitment, during which the fishery is based on an ageing stock, derived from occasional good year-classes, a high rate of exploitation will, during periods of low recruitment, lead to a very low abundance of adult herring. It must be recognised that under such circumstances the prospects for future reproduction may become endangered.

46. In addition to endangering the reproductive potential of the stock, a higher rate of exploitation has the disadvantage that it will enhance the already strong fluctuations in the annual catches, and it is unlikely to lead to a higher yield, considered on a per-recruit base.

47. In the light of these considerations the Committee considers it would increase the stock and the long-term prospect of the fisheries to reduce the fishing mortality rate on the immature herring and to avoid a further increase in the fishing rate on the adult stock of Norwegian spring-spawning herring.

Icelandic Spring and Summer Spawners

48. After a period of high exploitation, especially in the years 1961-62, in which the total landings of Icelandic spring and summer spawners rose from about 100 thousand tons (1957) to over 400 thousand tons (1962), landings declined to about 80 thousand tons in 1966-67. Estimates of stock size showed a decline from 930 thousand tons in 1962 to 270 thousand tons in 1966. Exploitation was high in 1962-66, the fishing mortality rate being 0.6 on the average. Since 1964 the fishery has been almost entirely based on immature and recruit spawning herring. The Icelandic Government has taken conservation measures for this fishery.

C. REGIONS 2 AND 3 FISHERIES

C.1 HERRING FISHERIES IN REGION 2

49. In last year's Report to the Commission, the Committee presented the results of assessments made by an expert Working Group of the state of the North Sea herring stock and of the effects of fishing on it. In its consideration of the North Sea herring problem in the light of these results, the Commission requested ICES to continue the scientific study of North Sea herring and also to provide scientific advice on the possible effects of any regulatory measures, which might be applied to the North Sea and Atlanto-Scandian herring, on other herring stocks

to which fishing effort might be diverted. Arrangements to meet these requests were duly made at the 1969 ICES meeting, and the results of further assessments by the North Sea Herring Assessment Working Group, which met in December 1969, of the North Sea herring fishery and stock, and of its appraisal of the state of herring stocks in other, adjacent areas are summarised below:-

C.1.1 Assessment of North Sea Herring Fishery and Stock

50. The results of the assessments presented last year, based on statistical and biological data up to 1967 indicated that in the years 1963-1965 a sharp increase in the fishing effort occurred, due, at least partly, to the rapid development of a large purse-seine fishery in the northern North Sea. This increase in effort led to the highest herring catch ever recorded in the North Sea (about 1.5 million tons), but it was followed by a decrease in the landings down to just over 1 million tons in 1967. The data available on catch composition suggested that the proportion of adult herring in the landings in later years declined and the fishery turned more to immature herring. It was estimated that under average environmental conditions the sustained yield of North Sea herring will not be likely to exceed about 850,000 tons of adult and juvenile herring combined and that a high fishing effort, as experienced in recent years, will lead to a low catch-per-unit-effort, wide annual fluctuations in the landings and few large-sized herring for human consumption; in addition there is the danger that the low abundance of adult herring will cause a reduction in recruitment. It was concluded that to effect a recovery of the stock it would be necessary to reduce the fishing mortality rate on North Sea herring to a level well below that experienced since 1964.

51. The latest information available at the recent meeting of the Working Group [1], including catch data for 1968 and provisional data for 1969 showed that catches in the years 1966-1968 at just over 1 million tons, were lower than the record level of 1.5 million tons in 1965 (the landings in 1968 were thus higher than those estimated in last year's report (830,000 tons). Provisional data up to November 1969 indicated a further, larger decrease to about 650,000 tons in that year. The data on catch composition suggest that, especially in the years 1967-68, a high proportion of the catches consisted of

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[1] Serious difficulties encountered by the Working Group in obtaining the complete landings statistics for some of the major components of the total fishery, made it impossible for its full report to be prepared in time to be appended to the report of the Liaison Committee

immature herring, less than three years of age, thus indicating that the tendency of the fisheries to turn more to immature has continued. Although accurate estimates of total effective fishing effort are difficult to make for recent years it seems doubtful if it has declined appreciably in the years since 1965.

52. The results of this latest assessment provided no basis for modifying the conclusions reached last year concerning the state of the North Sea herring stock, and of the need to reduce the fishing mortality rate in the total stock to restore it to a more satisfactory state. Thus, indications that the adult herring stock in the North Sea had declined severely in recent years were confirmed; mortality rates in recent years were found to be high in all areas; the catch-per-unit-effort of most countries' fisheries had decreased considerably and larval abundance data indicated that the adult stock in the late 1960s was only about 20% of that in the early 1960s. Moreover, the available data on the strengths of the most recent year-classes indicate that recruitment to the adult stock is likely to continue to be generally below average in the coming two years at least. In this regard the Committee wishes to emphasise that, although the adult stock level below which recruitment becomes related to stock size is unknown, it cannot be excluded that the maintenance of the high level of fishing effort will induce such a relationship, to the detriment of future recruitment.

53. At its recent meeting, consideration was also given by the Working Group to the principal features of different possible types of regulatory measures for North Sea herring, aimed at increasing the size of the adult stock. This could be achieved in principle by either increasing recruitment through a limitation of the immature herring fisheries or by reducing mortality in the adult stock or, preferably by a combination of the two.

54. Possible measures for achieving one or both of these ends and their general relevance to the regulation of the North Sea herring fisheries are summarised below. It should be noted that to achieve the recovery of the stocks to a satisfactory level the fishing mortality rate would have to be reduced to about 50% of its level in recent years. Under the stock conditions in 1968 this would be equivalent to a reduction in catch to about 500,000 tons, although if the present high level of exploitation is continued it would be considerably lower.

a) Minimum Mesh-Size

55. The introduction of a minimum mesh-size can only operate to achieve an increase of recruitment. However it is well known that with larger meshes the industry will almost certainly be faced with a serious meshing problem, causing losses of fishing time and possibly even losses of nets. Moreover, the effectiveness of mesh-size regulations in herring fisheries is very doubtful, as escaped fish may not be viable.

b) Closing of Spawning Grounds

56. Such a measure is normally aimed at protecting the spawning products and consequently at increasing recruitment although, in principle, it may also be used to reduce the fishing intensity on adults. For North Sea herring there is no direct evidence that fishing interferes with the spawning behaviour or is significantly destructive of spawn. Therefore, this measure could only have predictable effect through the reduction in adult fishing mortality. The proportion of the total catch, caught in spawning condition, is now extremely low in the North Sea so that such a measure could not achieve a substantial reduction in total mortality rate. An additional difficulty would be the exact definition of the spawning areas of North Sea herring.

c) Minimum Size

57. The introduction of a minimum size for herring would have its effect through an increase of recruitment to the adult stock.

58. Because of the difficulties in applying minimum mesh-sizes as discussed above, the direct effect would be to prohibit fishing on grounds, where small herring are dominant. The distribution of herring in the North Sea is such that small and adult herring are largely separated in space, the length dividing the immature from the adult herring being between 20 and 25 cm. Such a measure could therefore be applied in practice. However, because of inadequacies of the statistics available from some of the major fishing areas, notably the north-eastern North Sea and Skagerrak, it is difficult to quantify its effects either in reducing the total catch in the short-term or in increasing recruitment in the long-term, but both must be considerable.

d) Closed Area

59. A closed area could be used to reduce the mortality on either immatures or adults depending on the area closed. The areas to be closed to reduce mortality on the immature fish would be the eastern part of the central North

Sea, the southern part of the north-eastern North Sea and the Skagerrak, while those for adult herring would need to be mainly in the western and/or the north-eastern North Sea. Accurate prediction of the effect of such a measure on mortality of adult or immature herring, apart from the difficulties mentioned under "minimum size", is made very difficult because of diversions of effort to the "open" areas. Therefore, in order to achieve a substantial reduction in the mortality rate of either the adult or the immature fish, the area to be closed would need to be of considerable extent.

e) Closed Seasons

60. Closed seasons, like closed areas, could be used to achieve a reduction in mortality rate of immatures and/or adults. Moreover, the two are not necessarily mutually exclusive, as an area could be closed for part of the year. To obtain a substantial reduction in mortality rate a closed season regulation by itself would need to operate over a considerable part of the year.

f) Direct Restriction of Fishing Effort

61. This measure could be used to achieve a reduction in mortality rate on immatures and/or adults. If applied to all national fisheries, it would decrease the mortality rate of the adult stock and increase recruitment to it. The effect on fishing mortality of adults would be proportional to the reduction in effort, but no accurate assessment can be made of the increase in recruitment to the adult stock by reducing effort on the immature herring. The measurement of the total effective fishing effort in herring fisheries raises major problems due to the difficulties of equating the units of effort of different methods of fishing. Effective reduction of effort by any specified amount could probably only be achieved by a reduction in the activities of the fleets using each method of fishing. Subsequent changes in the type of effort would make assessment of the effect on overall effort very difficult for the reasons mentioned above.

g) Catch quotas

62. The effects of the introduction of a catch quota would be effectively the same as with a restriction in effort. A quota system could be specified which would achieve a reduction in mortality on both adults and immatures. It has the advantage over direct effort limitation that it is more easily quantified.

C.1.2 Herring Fisheries and Stocks in Areas to the West of the British Isles (Annex III)

63. In relation to the Commission's request for information on the effects of possible regulatory measures applied to the North Sea and Atlanto-Scandian herring on herring stocks in other, adjacent areas, the North Sea Herring Assessment Working Group confined its attention to consideration of the state of the herring stocks in the waters to the west of the British Isles since these are the stocks within the Convention Area to which fishing effort would most likely be diverted. The results of these considerations, which are set out in detail in Annex III, are summarised below.

64. On the basis of growth and meristic characters and other biological data, two main groups of herring on to which effort would most likely be diverted can be identified in this area. These are the herring inhabiting the Celtic Sea area to the south of Ireland, and those in the area to the north of Ireland and north-west of Scotland. Other smaller stocks of herring (eg Clyde; Isle of Man) are also known to occur in the area but these were not considered in the assessment.

a) Celtic Sea Herring

65. Landings of Celtic Sea herring which fluctuated between 3,000 and 8,000 tons in the period 1951-1956 increased sharply to over 25,000 tons in 1957-1959. They subsequently decreased again to reach 7,000 tons in 1962 but thereafter increased once more, especially after 1966 to 30,000 tons in 1968.

66. The fluctuations in landings during this period followed fairly closely the observed changes in fishing effort, the increase in fishing effort in the two periods of high landings probably being connected with failures of North Sea fisheries, first in the area of Downs herring (1957-1959) and later in the North Sea as a whole (1966-68). Estimates of total mortality rate which followed in general the changes in fishing effort were high (0.7-0.8) in the years of high landings and fishing effort.

67. Estimates of stock size, obtained from catch data, mortality rates and larval abundance estimates indicate a small stock of between 30 and 60 thousand tons. As is usual for herring, recruitment to this stock has been highly variable but has shown no clear trend, and the variability appears to have been the same throughout the period.

68. From the data available for this stock it seems unlikely that a further increase in fishing effort above the level of the most recent years would result in a sustained increase in yield from this stock.

b) North of Ireland and North-west of Scotland Herring

69. In the period 1950-1965 herring landings from this area were relatively stable, between 40 and 60 thousand tons, but they increased in the most recent years, 1966-68 to 80-90 thousand tons. This increase could probably be attributed partly to higher recruitment, especially from the 1963 year-class, but it is likely that the fishing effort also increased to some extent in these years. Total mortality rates were estimated to lie between 0.4 and 0.5, which is low compared with the North Sea and Celtic Sea herring. In addition, stock size estimates based on catch and fishing mortality rate data and the data from one larval survey indicate the presence in this area of a stock of at least 350,000 tons which, in association with the catch data points also to a relatively low rate of exploitation of this stock compared with the North Sea and Celtic Sea herring. As with the Celtic Sea herring, in the years 1950-68 recruitment fluctuated without any clear trend.

70. On the basis of the rather limited scientific data available it seems likely that this group of herring could support some sustained increase in fishing effort.

C.1.3 Bloden Tagging Experiment

71. This experiment began on 15th July, 1969 in accordance with the plans reported last year and will continue until 15th March, 1970. A Norwegian purse-seiner, m/s "Gerda Marie" (H-32-AV), was chartered for the experiment and has worked in the North Sea and the Skagerrak during this period. Mr. G. Sangolt from the Bergen Institute of Marine Research has served as superviser of the experiment. During the period the tagging vessel has been assisted by research vessels from different countries, an arrangement which has proved to be of great value for the success of the experiment.

72. The experiment has been carried out so far without any serious obstructions, and the plans set up by the Working Group have been followed to the greatest possible extent. The experiment has, however, been hampered by long periods of bad weather, especially in the late autumn of 1969; thus in November and December only 2,000 herring, caught in the open sea, were tagged. Nevertheless

by 15th February a total of 52,000 herring had been tagged and released at 26 different positions. Most of the herring were caught in the North Sea south of 57°N (The Bløden Area); only a few thousand tagged fish were released in the Skagerrak, and no herring were caught in the northern part of the North Sea north of 57°N and south of the south coast of Norway.

73. In accordance with the programme, a number of experiments to estimate the mortality of tagged fish have been carried out both in keep-nets in the open sea, and in tanks on board the tagging vessel.

74. A total of 1,499 recaptured tags have been reported to the ICES Secretariat up to 15th February, 1970. These tags come from Denmark (921), Germany,F.R. (128) and Norway (450).

75. Regular reports on the course of the experiment based on detailed reports from the supervisor, have been circulated to the members of the Working Group and Managing Committee.

76. The Working Group have had two informal meetings, in Dublin in September, and in Copenhagen in December 1969. Here it was decided that a) market sampling should be carried on until 1st August, 1970; b) after that date analysis of the deep-frozen samples should be carried out in Esbjerg by technicians from the participating countries; c) all data should be worked up for automatic data processing, and d) the Working Group should meet at the time of the annual meeting of ICES in 1970 to consider the working up of the data.

C.2 ASSESSMENT OF NORTH SEA DEMERSAL FISHERIES

77. A review of the current state of the main North Sea demersal fisheries was presented in last year's Report to the Commission, and at its meeting, the Commission asked ICES to continue the scientific studies of these fisheries. At the 1969 ICES Meeting two Working Groups were duly set up to continue and elaborate the earlier assessments. These were:-

1. A North Sea Roundfish Working Group to meet in April 1970, to study, in the first instance, the relationships between the cod in different parts of the North Sea, with a view to reconsidering on a regional basis the earlier assessment on the North Sea cod stocks as a whole.
2. A North Sea Flatfish Working Group to meet in June 1970, to study further the assessments made for sole and plaice, taking into account the recent changes in fishing effort and the influence of discarding at sea.

78. In relation to the further assessment of the state of the exploited demersal fish stocks, especially of roundfish, in the North Sea, the Liaison Committee strongly endorses a recommendation passed at the ICES meeting that further and more precise data on catches and length compositions of protected species, especially haddock and whiting, taken in the industrial fisheries in the North Sea should be collected as soon as possible by the countries concerned.

D. SELECTIVITY AND RELATED ITEMS

D.1 MESH SIZES AND TOPSIDE CHAFERS IN USE

98. As in past years, information on the mesh sizes and topside chafers in use in trawls and Danish seine-nets in the countries fishing in the Convention Area in 1969 was reported by a number of countries. This is summarised below.

a) Cod-end Mesh Sizes

99. Eleven countries submitted data for 1969 on mesh-sizes in use in trawl and seine-net fisheries in NEAFC Regions 1, 2 and 3. These are summarised in Table 4, together with two sets of data for 1968, which were received too late to be included in last year's report.

100. Two of the countries reporting for 1969 used only the ICES gauge, seven used a wedge-gauge, and two took measurements with both gauges. Of the two countries reporting for 1968 both used a wedge gauge.

101. Data for wedge- and ICES-gauges are only directly comparable for one country (C), which used both gauges on the same cod-ends. The result of these measurements shows that the readings with ICES gauge were somewhat lower than with the wedge-gauge, which confirm the general observation of comparative tests in the past.

102. The measurements reported show that the mean mesh-size in the fisheries for protected species in 1969 was in general agreement with the mesh-sizes prescribed by the Convention. However, it should be noted that it has not been possible to assess whether the reported data are representative of the mesh-sizes in use in the Convention Area. It should also be noted that some countries which have extensive fisheries in the Convention Area did not report on mesh-sizes in use.

103. In 1969 measurements of cod-ends of mid-water trawls were reported by one country and the data are included in Table 4. It should be stressed that information on the mesh sizes in use in pelagic trawls, especially where they are

being used in fisheries for protected species is important, and the Liaison Committee recommends that measurements for them should be reported to the greatest extent possible.

b) Topside Chafers

104. Specific information on topside chafers in use was reported by three member countries; Poland reported that in the fisheries carried out for demersal species by large stern trawlers, only the Polish chafer is used; the United Kingdom reported that 2 of 13 topside chafers dealt with in its submission were of the Polish type, whilst the remaining chafers were not specified. Norway reported that Norwegian fishermen are authorised to use only the Polish chafer.

105. In relation to the use of topside chafers the Committee wishes to draw the Commission's attention to the growing use of cod-ends of very thick polyamide twine by German stern trawlers in NEAFC Region 1, which may obviate the need to use topside chafers in this fishery. Experiments at Iceland and Newfoundland comparing such a double-braided thick polyamide twine (R 18 000 tex) cod-end with cod-ends made from the more usual polyamide twines (R 6484 tex and R 5000 tex) showed no significant differences between the selectivities of those two types of cod-end on cod and redfish.

D.2 VARIABILITY OF SELECTIVITY DATA (Annex IV)

106. A joint ICNAF/ICES Working Group on Selectivity Analysis met twice in 1969 to undertake a review of variability in selection data including the scientific basis of mesh size differentials for different twice materials. Its first report was submitted to the 1969 ICES Statutory meeting as document CM 1969/B:13. That report presented tabular data from selectivity experiments in ICNAF Subareas 1, 2 and 3 and ICES Subarea I and Divisions IIa, IIb and Va (NEAFC Region 1) together with the results of a statistical analysis of the variability of these data and observations on the effects of various physical properties of net materials and construction on selectivity.

107. The working group met again in January 1970 with the following terms of reference:

a) to extend its previous work to include data for ICNAF Areas 4 and 5 and NEAFC Region 2;

b) to investigate further all factors (including physical properties of net twines, biological factors, etc) which cause or may cause differences in mesh selection;

c) to examine the adequacy of the present system of mesh differentials used by NEAFC and ICNAF in relation to the principle of equivalent selectivity.

108. The report of this meeting of the Working Group (minus detailed tabular selectivity data) is appended as Annex IV. It gives tables of the summarised results of selectivity experiments separately for NEAFC Region 2 and ICNAF Subareas 4 and 5 and grouped together for ICNAF Subareas 1, 2 and 3 and ICES Subarea I and Divisions IIa, IIb and Va. The tables also give the calculated equivalent selectivities for various species based on only the chemical differences between the netting materials used.

109. The analysis made by the Working Group of the selectivity data for a wide range of twine types (both chemical material and construction) indicates that although the selectivities of some twine types are, on average, higher (or lower) than those of others (e.g. between polyamide and manila twines), the differences observed from the experimental data are highly variable. This may be due to the effects of factors (physical properties of the twine and netting, biological factors etc.) other than the chemical nature of the material. Therefore, it is not possible to determine reliably the magnitude of the selectivity differences between twine-types applicable throughout the Convention Area on the basis of one or a small number of experiments, conducted in a limited area and over a short period of time. The present system of mesh-size differentials used in the Commission's regulations is based mainly on the chemical nature of the twine from which the cod-ends are made. From the data available from experiments mainly on cod, haddock and whiting by trawl in different parts of the NEAFC Area it seems clear that, despite the high variability referred to above, the selectivity of trawl cod-ends made from both single and double braided polyamide synthetic twines is generally systematically higher than that of manila trawl cod-ends. For other synthetic twines, however, the position is less clear, although the selectivities of polyethylene and polypropylene cod-ends have tended to be somewhat lower on average than that of polyamide ones.

110. The Committee considers therefore that the results of the analysis of the selectivity data available provide no clear basis for recommending any specific modifications of the present system of differentials for double braided trawls, based on the chemical nature of the twine, but the limited selectivity data available for the synthetic cod-end materials now in use in Danish-seines and single braided trawls indicate that there is no longer any clear basis, on

grounds of selectivity, for a distinction being made in mesh size between Danish-seine and trawl cod-ends in all parts of the Convention Area or between single and double-braided trawl cod-ends in Region 2. For both Danish-seines and single braided trawl cod-ends the selectivity experiments which were used as a basis for this distinction being made initially were conducted with cotton and/or hemp cod-ends, which were the materials then being mostly used in the commercial Danish-seine and light trawl fisheries. These materials have been subsequently replaced almost entirely by synthetic fibres.