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JOINT WORKING PARTY ON NORTH ATLANTIC SALMON

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A. INTRODUCTION

1. The first report¹⁾ indicated the reasons for the appointment of this Working Party and gave an account of the first two meetings, which were held in Madrid and Copenhagen in May and October 1966. This report reviews the information received and describes the investigations made since 1966 and gives a record of the two subsequent meetings of the Working Party, held in Hamburg in October 1967 and in London in May 1968.

2. Some changes have taken place in the composition of the Party since 1966. Mr. Gulland's retirement from the Chairmanship of the Party and Mr. Allen's election as his successor were recorded in the first report. Unfortunately, Mr. Allen was not able to take the Chair at a meeting of the Working Party because his appointment as Director of the Biological Station at Nanaimo in May 1967 compelled him to resign his Chairmanship during the interval between the second and third meetings. Mr. Allen was succeeded as Chairman by Mr. B. B. Parrish.

3. The following countries and organisations were represented at the Third and Fourth Meetings of the Joint Working Party, as follows:-

	<u>October 1967</u>	<u>May 1968</u>
Canada	R. L. Saunders	F. D. McCracken A. W. May G. F. M. Smith
Denmark	Sv. Aa. Horsted	Sv. Aa. Horsted
England and Wales	I. R. H. Allan	I. R. H. Allan
Ireland	Miss E. Twomey A. E. J. Went	A. E. J. Went
Scotland	B. B. Parrish (Chairman) K. A. Pyefinch (Rapporteur)	B. B. Parrish (Chairman) K. A. Pyefinch (Rapporteur)
Norway	L. Rosseland	Unable to attend
Sweden	B. Carlin	Unable to attend
U.S.A.	B. Kimsey J. A. Posgay G. J. Ridgway	B. Kimsey J. A. Posgay G. J. Ridgway
ICNAF	L. R. Day	L. R. Day

B. CATCH STATISTICS

(a) West Greenland Catches

4. Details of the catches in West Greenland, from 1960-1967, are given in Table 1A. This table shows (a) the rapid increase in the inshore catch from 1960 to 1964 and the maintenance of a high level of catch in subsequent years, and (b) the beginning of an offshore fishery in 1965 and its rapid development over the following two years. The figures quoted do not include fish consumed locally but this is a small part of the total catch (estimated as 50-100 tons in 1966).

¹⁾ Report of the ICES/ICNAF Joint Working Party on North Atlantic Salmon, 1966. International Council for the Exploration of the Sea, Cooperative Research Report, Series A, No. 8, 27 pp. (1967).

5. Over recent years there has been a tendency for the inshore fishery to extend further northwards; this was particularly noticeable in 1966 and 1967. The mean size of the fish caught inshore in 1967 increased and the data from the research catch suggest that this was due to an increase in the growth rate of salmon in the area rather than to a difference in the distribution of the fish along the West Greenland coast. The examination of scale samples from fish caught in the nets fished for research purposes in 1965, 1966 and 1967 (supported by samples from fish caught over a wider area of coast in 1966) indicate that all the salmon in this fishery have already spent at least one winter in the sea and that nearly all were entering upon their second winter in salt water. If they return to home waters, they will be salmon which have spent at least two winters in the sea. On the basis of the catches made in the inshore fishery from 1965 onwards, however, there is no evidence of any major change in fishing activity for this part of the West Greenland fishery over this period. The number of nets sold each year is a rough indication of major changes in fishing activity and Denmark undertook to bring this information, at present available only up to 1964, up to date if at all possible.

6. The records from the gill-nets fished for research purposes in 1965, 1966 and 1967 have been analysed to ascertain whether the catch per unit effort for these nets would be of value in estimating the abundance of the exploited salmon stock but this study failed to produce clear cut results.

7. The catch taken offshore has increased from 1965 onwards and, in terms of the number of boats taking part in this fishery, activity in 1967 was at least twice that in 1966.

(b) Home Water Catches

8. Details of catches in home waters, over the period 1960-1967 are presented in Table 1B. It should be particularly emphasized that, with the exception of the Scottish catches, where separate figures are given, the figures quoted refer to catches of salmon¹⁾ (i. e., fish which have spent two winters, or more, in the sea) and grilse¹⁾ (i. e., fish which have spent only one winter in the sea). This point is particularly important in the light of the information given in para. 5, which indicates that the fish which form the grilse fishery in home waters are not caught on the west coast of Greenland.

9. The figures given in Table 1B do not indicate any marked trend in home water catches over a period which covers five years (1960-64, inclusive) before the West Greenland fishery attained its present level of catch or since. Further, if the records shown in Table 1B are adjusted (following the footnotes to this table), so as to show only the catches of fish with two sea-winters or more, much the same picture emerges. Estimates of the total weight of these fish caught in Ireland, England and Wales, Sweden, Norway and Scotland over the period 1960-1966 are given in Table 1C.

10. Detailed information about home water catches is clearly an important element in the assessment of the effects of the West Greenland fishery and it is therefore

recommended

that all countries should make every effort (a) to provide separate returns for

1) In the remainder of this report SALMON refer to fish which will spend two or more winters in the sea before returning to home waters, and GRILSE to fish in home waters which have spent one winter in the sea.

catches of salmon and grilse, and (b) to obtain more detailed records of the size, age composition and sex ratio of their salmon stocks in home waters, even if these could only be obtained for limited areas.

11. One other change in home water catches which deserves mention is the decline in salmon catches during the spring in Ireland and Scotland. In Ireland, this decline has been apparent for many years but in Scotland the decrease began about 1956. In Scotland, the decrease in salmon catches during the spring has come to be compensated by increased salmon catches during the summer so that, overall, the Scottish salmon catches have tended to increase over recent years. In Ireland the decrease in the spring salmon catch has led to an overall decrease, since Irish summer salmon runs have been small for at least the last twenty-five years. In general terms, many Irish rivers have become predominantly grilse rivers.

12. The information available on catch per unit effort for the home water fisheries (Table 2) provided by some countries has been examined. Although these estimates have their limitations, they confirm the impression given by the catch statistics summarised in Tables 1B and 1C. It is therefore

recommended

that as many countries as possible should make further and more detailed studies of past catch per unit effort data.

(c) The Development of Sea-Fisheries in other Areas

13. The Working Party's attention has been drawn to a fishery which is developing off the Norwegian coast, from Bergen northwards to Finmark. This fishery started as a drift-net fishery in the early 1960's but, in 1966, six or seven Danish long-line boats had participated. In 1967, perhaps over 20 Danish long-liners had taken part, together with one or two Swedish and some Faroese and Norwegian boats. Fishing took place from 12-200 miles offshore and had started in April, continuing during May and most of June. Full details of the catches taken in this fishery are not yet available, but reports from commercial fishermen suggest that 100-200 tons of grilse and salmon (including kelts) were caught. It seems likely that this fishery will develop further in 1968, but information on this point is not yet available.

14. The Working Party was also informed about a catch which had been landed in Scotland, a day or so before their meeting in May 1968. This catch was landed by a Danish boat, the "Faro Bank", which had been fishing in an area from 60° 30' N to 70° N and 8° to 10° E (about 100-200 miles west of the Lofoten Islands). Approximately 1,400 fish, weighing 3½-4 metric tons, were landed and the fish ranged in length from 50-100 cm. Examination of scale samples from 233 of these fish indicate that 84% had spent two winters in the sea and the percentages of two-, three-, four- and five-year old smolts were 22.3, 47.6, 27.5 and 2.6 respectively. The skipper reported that about 25 boats were fishing in the area while he was fishing and that salmon appeared to be plentiful.

15. Reports from Thorshavn have given preliminary details of the results of a cruise of the Faroese research ship "Jens Chr. Svabo" which, during the period April 8-23, 1968, caught 182 salmon (including one tagged as a kelt in the River Polly, western Scotland the previous winter). This catch was made from seven settings of long-lines, made to the north of the Faroes. In all,

3,580 hooks were fished and the efficiency ranged from 1 fish/9 hooks to 1 fish/100 hooks (mean 1 fish/20 hooks). Drift-nets were also set on one occasion, but did not catch any fish. It was reported that two or three commercial boats were now fishing in the area.

C. RESULTS OF RESEARCH

16. Paras. 17 to 30 below summarise the research undertaken in connection with the investigation of the West Greenland fishery, both in home waters and in West Greenland. The latter has largely been possible because of the active co-operation of the staff of the Greenland Fishery Investigations. They have put two research vessels at the disposal of the investigators for the whole of their periods of stay; have arranged laboratory facilities and living accommodation; provided for the transport of gear and, by their active participation, have given every assistance to all the investigations in Greenland.

(a) Recaptures in the West Greenland Fishery of Smolts Tagged in Home Waters

17. These recaptures are summarised in Table 3, which gives details of the results from the smolt tagging experiments started during the period 1963-1966 (inclusive). It will be noted that full results are not yet available for the later experiments. Details of the numbers of smolts tagged in 1966 and 1967 are given in Table 4.

18. The number of fish caught in the West Greenland fishery which had been tagged as smolts in Canada and the number caught per thousand fish tagged, increased sharply in 1966. These results suggest that the proportion of fish of Canadian origin in the West Greenland fishery increased markedly in 1966, although the data available suggest that it was not maintained at this high level in 1967. However, these results must be accepted with some reserve because different types of tag were used in Canada and some other countries.

19. It should be noted, however, that, although this difference may affect the relationship between the numbers of Canadian and other tags detected on fish in Greenland, it should not affect the recaptures of Canadian tags over successive years in Greenland, since the Canadians have used the same type of tag throughout the period covered in the table. Nevertheless, it is clearly most important that the type of tag used should be standardised and it is therefore recommended that steps should be taken to achieve this. It was noted that the tags used for smolts by England and Wales and by Scotland in 1968 are of the Canadian type, so that a substantial degree of standardisation has already been achieved.

20. The Working Party noted the significant returns from the West Greenland fishery of smolts tagged in the U.S.A. in 1966. The ratio of returns from the West Greenland fishery to the number tagged is about 4 to 10,000, roughly similar to the ratio for England and Wales and Sweden.

(b) Recaptures in the West Greenland Fishery of Kelts Tagged in Home Waters

21. Though most of the fish tagged in home countries have been smolts, some adults have been

tagged, usually as kelts after spawning or stripping. Some of these have been recaptured subsequently in Greenland, usually in the year following tagging, and this information is given in Table 5.

(c) Recaptures of Fish Tagged in West Greenland

22. Tagging experiments were undertaken on the west coast of Greenland in 1965, 1966 and 1967. Most of the fish for tagging have been caught in gill-nets, set from the shore in a similar manner to the local gill-net fishery, but tests were made of a Norwegian kilenot in 1965 and in 1967 some Northumberland T-nets (which are basically similar in design to the kilenot) were fished. The gill-nets caught many more fish than the other types of net but they were generally in a poor condition and only a small proportion (one-third or less) was tagged. The poor performance of the gill-nets in this respect in 1965 and 1966 was the main reason why Northumberland T-nets were tried in 1967 since, as these are a form of trap net, the fish caught in them should be in better condition for tagging. This proved to be the case, as over 50 per cent of the T-net catch was taggable, but unfortunately these nets only caught a small number of fish (about 2 per cent of the total research catch in 1967). As weather conditions were unfavourable for part of the last period and as it was not always possible to fish these nets in the most advantageous sites, further tests are to be made in 1968.

23. During the three years, 1,326 salmon have been tagged on the coast of West Greenland and, so far, 35 of these have been recaptured in the West Greenland fishery and 9 at distant sites. Most of the West Greenland recaptures have been made in the vicinity of the tagging site and within ten days of tagging. Of the distant recaptures, 4 have been made in Scotland, 3 in Canada and 2 in Ireland. These details are summarised in Table 6.

(d) Blood and other Biochemical Studies

24. One of the most important requirements of the Working Party's study is the identification of the origin of the salmon exploited at West Greenland and the home waters to which they return. In relation to this problem, in addition to tagging experiments, research has been conducted on the biochemical properties of blood and other tissues and on parasites.

25. Work on the blood characteristics and the biochemical characteristics of other tissues is being carried out by England and Wales and by Scotland. In England and Wales attention was initially concentrated on the use of iso-immune reagents to ascertain whether polymorphism was present but more attention has recently been given to a study of eye lens proteins. Eye lenses are easy to collect, can be removed from the fish without affecting its saleable value and can be preserved for examination later. Eye lenses have been collected from Greenland and three sites in the United Kingdom and arrangements have been made for samples from Canada.

26. Scottish workers have examined five possibilities, (i) variations in the haemoglobins in salmon from different areas, (ii) variations in the lactic dehydrogenases, (iii) variations in the liver esterases, (iv) blood groups, and (v) serum proteins. Of these, (iii) and (iv) seem to be the most promising and work is now being concentrated on these investigations.

27. Some of these investigations are producing interesting results, but their full interpretation is hampered by lack of knowledge of these characteristics among salmon in home waters. In general, however, there are several indications that the biochemical characteristics of many salmon in the West Greenland fishery resemble those of Canadian rather than European stocks.

(e) Work on Parasites

28. Work on the parasite fauna of Atlantic salmon is going on in Canada, Ireland and Scotland to discover whether there is a parasite which could serve as a reliable biological tag. So far, no fresh water parasite has been found which seems likely to be suitable and the most promising possibilities seem likely to be among the marine parasites. As in biochemical investigations, this work is hampered by lack of knowledge of the parasite fauna and its variations among home water stocks.

(f) Other Investigations

29. In addition to the cruise of the "A. T. Cameron" (Canada), in July and August 1965, which was noted in the first report, two other research vessel cruises have been made to the West Greenland - Davis Strait area. In October 1966, the "Ernest Holt" (England and Wales) visited the Davis Strait to catch fish for tagging. In all, 24 salmon were caught in gill-nets, (mainly off Disko Fjord) but only one proved suitable for tagging. In September and October 1967, the "A. T. Cameron" visited West Greenland to gather information on the fishery and to make catches for tagging and for other studies. Drift-nets and long-lines were used and 54 salmon were caught, 53 in the drift-nets and one on long-line. None of these fish proved suitable for tagging. Further oceanic catches, east of the northern Labrador Shelf, were made by the "A. T. Cameron" in March-April 1968. Twenty-three fish were taken in five overnight gill-net sets.

30. Denmark has investigated the meristic and morphometric characters of tagged fish recaptured at West Greenland, but the results obtained do not suggest that this is likely to be a particularly useful means of analysing the West Greenland stock, though differences in the number of fin-rays in the dorsal fins may be significant. Work on meristic characters of smolts has been started in Canada.

D. FURTHER ASSESSMENT OF THE EFFECTS OF THE WEST GREENLAND
FISHERY ON TOTAL AND HOME WATER SALMON CATCHES

31. In the first report of the Working Party some preliminary conclusions were reached, on the basis of the few data available at that time, relating to the origin and composition of the stock exploited at West Greenland and the effects of this fishery on total and home water catches. Further detailed consideration has been given to these conclusions in the light of new scientific information and data which have been collected in the course of investigations carried out since then and summarised in the preceding sections. Of major importance amongst these have been (a) the very extensive programmes of smolt tagging in the river systems in both North America and Europe, which have provided additional information on the home water sources from which the stock

exploited at West Greenland are derived; (b) the tagging programmes conducted in 1965, 1966 and 1967 at West Greenland which, although not providing a large tagged population in good condition, have provided conclusive evidence that at least some of the fish at West Greenland subsequently return, as two-sea-winter fish, to home waters in the year following their presence at West Greenland; (c) the development of improved catch statistics collection systems for the home water fisheries, including in some countries separate statistics of grilse and salmon catches and estimates of catch per unit effort.

32. Although these new data do not permit firm estimates to be made of the magnitude of the effects of the West Greenland fishery on home water catches, especially in the river systems of individual countries, they allow some further conclusions to be drawn in confirmation or elaboration of those presented in the first report of the Working Party. They are summarised below:-

(a) The numbers of pre-grilse exploited in the West Greenland fishery are negligible, and the few which are caught are likely to be of local origin. Therefore, the West Greenland fishery can have no direct adverse effect on the numbers of grilse returning to home waters, and hence on the fisheries for them. Therefore, any assessment of the effects of the West Greenland fishery on the total catches in home waters must take into account the relative proportions of grilse and salmon in the exploited stocks. From the data in Table 1B, it is evident that in the Irish and Swedish west-coast fisheries, grilse make up over three-quarters of the total catch by weight. The potential, direct effect of the West Greenland fishery on the total catches (grilse plus salmon) in these countries is therefore likely to be less than in those other countries to which salmon exploited at West Greenland return, where the proportion of grilse in the total home water catch is much smaller.

(b) Data obtained from the small numbers of fish tagged at West Greenland and recaptured in home waters show them all to have spent two winters in the sea. This suggests that the major part of the stock exploited at West Greenland is composed of fish, which, if returning to home waters, would belong to the two-sea-winters component of the exploited stock there. This component makes up a significant part of the exploited stock of salmon in most countries.

(c) The recaptures at West Greenland in 1966 and 1967 of fish tagged as smolts in home waters confirm the results of the earlier investigations in suggesting that the proportion of the exploited stock at West Greenland, originating from Canadian river systems is higher than from any other country; indeed the proportion originating from Canada would appear to have increased in 1966 (although differences in the efficiency of recovery of the tags used in different countries may have caused some bias in the estimates).

The more recent data also confirm the earlier results in showing no recaptures at West Greenland of fish liberated as smolts off the west coast of Norway. It seems clear, therefore, in view of the large numbers of smolts tagged in Norway that very few, if any, of the salmon exploited at West Greenland originate from Norwegian rivers in which smolts have been tagged.

(d) In the earlier assessments it was estimated that the presence of a West Greenland fishery would result in a lower total salmon catch by weight (West Greenland plus home waters), than it would have been in the absence of a West Greenland fishery, only if the exploitation rate in home waters of the fish which have visited West Greenland (i.e., the proportion of the fish present at West Greenland which were subsequently caught in home waters) exceeded about 70 per cent

(assuming no significant changes in recruitment, growth and natural mortality rate resulting directly from the fishery). If it were less than this, the West Greenland fishery would increase the total catch by weight. This was based on a preliminary estimate (using the mean weights of fish at West Greenland and of two-sea-winter salmon in Canada and assuming that they applied to the fish returning from West Greenland to home waters) of an average increase in weight of 50 per cent between a fish in the West Greenland fishery and its return to Canadian home waters. Similar Scottish data suggest that the estimate of 50 per cent was too high for the salmon returning to European river systems. This suggests that the estimate of 70 per cent for the 'break-even' value of the exploitation rate in European home waters is too low and that the appropriate value for them would be about 80 per cent.

The available information on exploitation rates in the home water fisheries in those European countries from which salmon are known to move to West Greenland points to a rate of exploitation for even the fish entering the river system lower than the 70-80 per cent break-even values, so it seems clear that it will be much lower than this for the fish which have returned from West Greenland, bearing in mind that the natural losses between West Greenland and home waters have to be taken into account in the estimate. The evidence therefore suggests that at the present rate of exploitation in the European fisheries, the West Greenland fishery has resulted in an increase in the total catch (West Greenland plus home waters) by weight, of those salmon from European rivers which visit West Greenland.

The situation regarding the effect of the West Greenland fishery on the total catch by weight (West Greenland plus home waters) of those salmon of Canadian origin is less clear. As indicated in the first report of the Working Party, data for the fish entering home waters in one of the major Canadian salmon river systems (Miramichi) gave estimates for the rate of exploitation of over 90 per cent in 1964 and 1965. Thus it is possible that, if the losses between West Greenland waters and Canadian home rivers are small, the break-even value and the exploitation rate of the fish returning from West Greenland might have been exceeded. Unfortunately the magnitude of the natural losses is not known. Further, there are no reliable estimates of the rates of exploitation in the fisheries in other Canadian river systems, although they are thought to be lower than that given above for the Miramichi.

(e) The records of recaptures in home waters of salmon tagged at West Greenland have established that at least some of the salmon present in the exploited stock there subsequently return to home waters in North America and Europe. This indicates that the presence of the fishery at West Greenland will tend to reduce the numbers of salmon available to the fisheries in home waters in those countries and river systems to which fish present at West Greenland return. In the first report it was estimated that this reduction would probably be greater in North America than in Europe and that for a West Greenland catch of 1,000 tons the reduction in the European catches would be less than 100 tons in each country (in some countries it would be much less). As the data in Table 1A show, the catch at West Greenland has not increased greatly since that time so that these estimates represent, for the size of the West Greenland fishery since 1963, very roughly the upper limit of the losses of salmon catches in European home waters due to the West Greenland fishery. It is evident from the catch statistics in Table 1B that, in fact, the home water catches of salmon have increased during this time. This, however, is not in conflict with the statement above since the losses are estimated in relation to the catches which would have been taken in the absence of a West Greenland fishery.

The catch taken in any year is influenced by factors affecting the abundance and availability of the stocks in home waters, e.g., year-class fluctuations. It seems likely that in recent years the

stocks of salmon have experienced above average recruitment, which has increased the abundance above its previous level.

33. In summary, therefore, although only rough estimates of the effects of the West Greenland fishery on total and home water fisheries can be made, the available data suggest that the West Greenland fishery at the size it had reached in the years 1964-1967, resulted in an increase in total (West Greenland plus home waters) yield of European salmon and relatively small losses in home water catches in most, if not all, European countries. It is evident, however, that while the inshore fishery at West Greenland has become stabilized at the level of 1,000-1,200 tons annually, the offshore fishery is increasing rapidly and seems likely to continue to do so both off West Greenland and in other areas. Clearly the losses to the home water stocks of the salmon which have visited West Greenland and the other exploited areas in the open sea will increase as the magnitude of the offshore fisheries increases. It should be noted that while the offshore fishery at West Greenland is currently being conducted close to the inshore one and is therefore likely to be exploiting members of the same salmon stock, it is possible that further extensions of this fishery might include the exploitation of other components of the total stock occurring in the open sea, especially pre-grilse. Indeed, the fishery which has developed recently off the west coast of Norway is reported to exploit a wide range of sizes and ages, including pre-grilse.

E. FUTURE RESEARCH PROGRAMMES

(a) Programmes for 1968-1969

34. The research programme for 1968 is largely a continuation of projects which have already been started and most of these have been mentioned or described in Section C (paras. 17-30) of this report. It is therefore only necessary to summarise them in this section. The list is set out below.

(i) Investigations in West Greenland

1. Continuation of the inshore tagging programme, using Northumberland T-nets. Some gill-nets will be fished but the catch will be used to supply material for Items 4 and 5 below and not as a source of fish for tagging (Denmark, England and Wales, Scotland).
2. Investigation of long-lining as a method of obtaining taggable fish, both in the offshore and the inshore fishery (Denmark, England and Wales, Scotland).
3. Sampling of the salmon catches at points on the West Greenland coast other than those covered by the research fishery (Denmark).
4. Continuation of biochemical investigations on salmon caught inshore (Scotland).
5. Continuation of parasite studies on West Greenland salmon (Scotland).
6. Investigation of the offshore fishery by means of observers on the commercial vessels taking part in this fishery (Canada, England and Wales, and Scotland if possible).

These items are not necessarily mutually exclusive, e.g., the fish used for biochemical investigations can also be used for parasite studies, and there are some projects, e.g., the

collection of eye lenses (England and Wales) which can be covered by a number of the items listed above. Although Ireland cannot take part directly in this part of the programme, they could contribute one worker if required.

(ii) Investigations in Home Waters

1. Continuation of smolt and, where practicable, kelt tagging programmes (Canada, England and Wales, Iceland, Ireland, Norway, Scotland, Sweden, USA).
2. Maintenance of records of home water catches and provision of further information about these catches (particularly catch composition and sex ratio) in as much detail as possible (Canada, England and Wales, Iceland, Norway, Sweden and USA).
3. Continuation of biochemical investigations (England and Wales, Scotland).
4. Continuation of work on the parasite fauna (Canada, Ireland, Scotland).
5. Investigations of meristic characters of freshwater stages (Canada).

(iii) Investigations in other Sea-Areas

It is clear that the sea-fishery off the Norwegian coast and the catches made this year to the north of the Faroes should be investigated as soon as possible although this cannot be readily undertaken with the present research resources while maintaining detailed studies in the West Greenland area. It is, however, of major importance that as an essential first step statistics of catches and data on their composition should be collected for these fisheries.

(b) Programmes for 1969 onwards

35. Information of major importance for an assessment of the effects of the West Greenland (or any other) sea-fishery is (a) a reliable estimate of the size of the population being fished (in West Greenland estimates may be needed for the inshore and offshore populations) and, (b) a reliable estimate of the proportion of the Greenland salmon population which returns to home waters. Therefore, research effort is likely to have to continue to be directed towards the solution of these problems.

36. It is possible to make calculations which give rough estimates of these quantities but, as these calculations all involve several arbitrary assumptions, the results cannot be regarded as reliable and, indeed, it is possible to produce a wide range of results by manipulation of the assumptions involved. The only method available for making these estimates directly is by tagging enough fish, in good condition, throughout the fishery. So far, none of the methods used for catching salmon in West Greenland have fulfilled these requirements and the immediate essential, therefore, is to discover some method which will do so. It is clear that this is not an easy task. Gill-netting or drift-netting have so far proved inadequate and the first tests with T-nets have not been outstandingly successful. The possibilities of long-lining are to be investigated this year and, if this does not prove successful, trolling or some other method of trapping might be investigated.

37. As mentioned in Section C, biochemical and parasite studies are being undertaken in relation particularly to determining the origin of the salmon exploited at West Greenland and in the home waters to which they return. As yet, too few data are available to gauge the outcome from this

work so that its continuation and the precise nature of the techniques in future will be determined in the light of the work currently in progress.

F. RECOMMENDATIONS

38. The following recommendations were made:-

- (a) That efforts should be made to provide separate records of grilse and salmon catches in home waters. Where possible, more detailed records of home water catches (covering net catches and catches made by rod and line) should be provided, including information on the length and weight of the fish caught, sex ratio and age composition of the catch.
- (b) That, where possible, more detailed information should be provided on catch per unit effort for home water and Greenland catches.
- (c) That efforts should be made to standardise the type of tag used for smolts in those countries which contribute fish to the West Greenland fishery.

G. TABLES

Table 1. Catches at West Greenland and from the home waters of some countries, 1960-67, in metric tons and round fresh weight.

A. West Greenland Area

	<u>Norwegian</u>	<u>Drift-Nets</u> <u>Faroese</u>	<u>Danish</u>	<u>Greenland</u> <u>Inshore Fishery</u>	<u>Total</u>
1960	-	-	-	?	?
1961	-	-	-	127	127
1962	-	-	-	244	244
1963	-	-	-	466	466
1964	-	-	-	1,539	1,539
1965	+	36	-	825	861
1966	32	87	-	1,251	1,338
1967	78	142	85	1,283	1,588

+ Figures not available, but catch known to be less than Faroes.

B. Home Waters. (Salmon and grilse, except where shown separately)

	<u>Ireland^a</u>	<u>England and Wales^b</u>	<u>Sweden^c</u>	<u>Norway^d</u>
1960	514	281	30-50	1,659
1961	522	231	30-50	1,533
1962	1,180	318	30-50	1,935
1963	1,130	324	30-50	1,786
1964	1,188	305	30-50	2,157
1965	1,112	319	30-50	2,000
1966	1,090	379	30-50	1,863
1967	1,226	407	30-50	2,052

	<u>Scotland</u>	<u>Canada^e</u>	<u>USA</u>
	<u>Salmon</u>	<u>Grilse</u>	<u>Total</u>
1960	945	468	1,413
1961	807	370	1,177
1962	999	713	1,712
1963	1,266	406	1,672
1964	1,197	687	1,884
1965	1,048	542	1,590
1966	1,049	546	1,595
1967	1,223	868	2,091

C. Combined Catches. (Combined catches of salmon in Ireland, England and Wales, Sweden, Norway and Scotland).

<u>Year</u>	<u>Combined Salmon Catch</u>
1960	2,719
1961	2,435
1962	3,203
1963	3,336
1964	3,581
1965	3,291
1966	3,201
1967	3,601

- a Grilse seem to be about 70-80% by weight or 80-90% by number in total Irish catches. Commercial catches only.
- b Salmon and grilse. Proportions of grilse in regional catches vary from 10% to 40% and average 22%.
- c Estimated 75% grilse. West coast catch only.
- d Includes not more than 5% sea trout. Estimated 15% grilse based on (i) returns from fish merchants and, (ii) tagging data.
- e Commercial catches only; angling catches (mostly grilse) are about 10% additional. Very few grilse are taken in Nova Scotia and New Brunswick but form a significant part of Newfoundland catches.

Table 2. Estimates of catches per unit effort for some home water fisheries.

	<u>Canada</u> ^a	<u>Ireland</u>		<u>Foyle Area</u> ^b	<u>Norway</u> ^e	<u>Scotland</u>	
	<u>(Drift Nets and Traps)</u>	<u>(Drift Nets)</u> ^c	<u>(Licences)</u> ^d	<u>(Drift Nets)</u>	<u>(Bag Nets)</u>	<u>(Fixed Engines)</u> ^f	<u>(Net and Coble)</u> ^g
	(lbs.)	(numbers)	(lbs.)	(numbers)	(kg)	(numbers)	(numbers)
1960	169	325	950	104	172	12.8	84.1
1961	159	224	1,030	- ^h	158	12.3	60.9
1962	178	563	2,210	297	175	14.8	83.6
1963	193	456	1,940	334	177	19.9	109.3
1964	266	430	1,720	392	195	23.2	98.6
1965	262	520	1,700	361	172	17.8	84.0
1966	249	516	1,250	375	154	19.4	95.0
1967	248	733	1,801	524	154	21.6	130.2

a Miramichi area, salmon only. Average of mean monthly catch/unit effort for both types of gear throughout open seasons for each type. Units of effort taken as 1 trap net or 200 fathoms of drift net, as defined in FRB Tech. Rept. No. 29.

b Irish Republic and Northern Ireland.

c Salmon and grilse per drift net.

d Pounds salmon and grilse per licence.

e Salmon and grilse per bag net.

f Salmon only, catch/net/month.

g Salmon only, catch/crew/month.

h Not available.

Table 3. Number of smolts tagged and recovered in Greenland and home waters up to the end of 1967.

<u>Country</u>	<u>Year of Tagging</u>	<u>No. Tagged</u>	<u>Greenland</u>	<u>Recoveries</u>		<u>Total^a</u>
				<u>Grilse</u>	<u>Salmon</u>	
Canada	1963	13,182	15	201	48	264
	1964	63,877	16	306	141	463
	1965	62,738	139	548	361	1,048
	1966	87,618	82	343	241	666
Scotland	1963	17,748	10	307	188	505
	1964	12,180	6	299	233	538
	1965	13,239	9	160	125	294
	1966	25,407	23	461	-	-
England and Wales	1963	9,485	9	16	32	57
	1964	17,129	10	33	99	142
	1965	5,974	12	35	59	106
	1966	12,999	5	20	-	-
Norway	1963	10,975	0	88	94	182
	1964	10,653	0	205	105	310
	1965	11,080	0	112	57	169
	1966	18,174	0	435	-	-
Iceland	1966	8,449	1	66	-	-
Ireland	1966	15,000	-	-	-	-
Sweden	1966	11,507	7	745 ^b	-	-
USA	1966	82,000	32	24	-	-

a All recoveries, Greenland and home waters.

b Includes recaptures from all places other than Greenland.

Table 4. Numbers of smolts tagged, 1966 and 1967.

<u>Country</u>	<u>Hatchery</u>	<u>1966</u>		<u>Hatchery</u>	<u>1967</u>	
		<u>Wild</u>	<u>Total</u>		<u>Wild</u>	<u>Total</u>
Canada	78,896	8,722	87,618	111,488	15,683	127,171
Denmark	4,270	0	4,270	2,696	0	2,696
England and Wales	9,668	3,331	12,999	18,522	4,218	22,740
Iceland	8,367	82	8,449	10,061	153	10,214
Ireland	15,000	0	15,000	10,000	0	10,000
Norway	16,163	2,041	18,174	20,421	4,214	24,695
Scotland	8,000	17,407	25,407	4,451	20,993	25,444
Sweden	11,180	327	11,507	4,999	564	5,563
USA	82,000	0	82,000	80,700	0	80,700

Table 5. Recaptures of tagged kelts in Greenland and home waters up to the end of 1967.

<u>Country</u>	<u>Year of Tagging</u>	<u>No. Tagged</u>	<u>Recaptures</u>		<u>Total</u>
			<u>Greenland</u>	<u>Home Waters</u>	
Canada	1963	1,519	0	677	677
	1964	1,995	1	613	614
	1965	4,272	0	1,612	1,612
	1966	7,363	1	981	982
England and Wales	1963	185	2	9	11
	1964	184	2	7	9
	1965	181	1	10	11
	1966	109	1	4	5
Ireland	1963	2,207	2	31	33
	1964	2,351	2	70	72
	1965	2,695	2	34	36
	1966	2,972	1	40	41
Scotland	1963	134	0	2	2
	1964	233	0	5	5
	1965	1,435	3	31	34
	1966	901	3	21	24
USA	1963	166	1	7	11 ^a
	1964	225	0	16	23 ^a
	1965	191	2	8	18 ^a
	1966	647	4	14	30 ^{a, b}

a These totals include tags returned from Canadian waters.

b Provisional total.

Table 6. Recaptures (to 31st August 1968) of fish tagged in West Greenland

<u>Year Tagged</u>	<u>Number Tagged</u>	<u>Local Recaptures</u>		<u>Number</u>	<u>Distant Recaptures</u>	
		<u>Number</u>	<u>Days Absence</u>		<u>Location</u>	
1965	223	2	3, 26	1	Canada (1, S. W. Newfoundland)	
1966	728	28	1- 8 days (24) 10-50 days (4)	4	Canada (1, Miramichi estuary) Scotland (3, River Tweed (2), River Spey)	
1967	375	5	1-21	4	Canada (1, Indian Head, Labrador) Ireland (2, River Slaney, River Barrow) Scotland (1, River Tay)	

H. APPENDIX

Working Papers 1967-68

ICES/ICNAF Salmon Document

- 67/1 Activities of State of Maine Salmon Program, 1966-67, by Alfred L. Meister and Richard E. Cutting. (also ICNAF Res. Doc. 67/41)
- 67/2 A preliminary report of the composition of the spawning runs of Atlantic salmon (*Salmo salar*) in Maine rivers for period 1926-1966. by Alfred L. Meister and Richard E. Cutting. (also ICNAF Res. Doc. 67/42)
- 67/3 Statistics on catch (1960-66), tagging (1966) and capture (1960-66) of Atlantic salmon in Ireland. (also ICNAF Res. Doc. 67/43)
- 67/4 Marine migration of Atlantic salmon kelts tagged in Maine, USA. by Richard E. Cutting and Alfred L. Meister. (also ICNAF Res. Doc. 67/57)
- 67/5 Notes on salmon caught in Greenland, 1966. by K. H. Balmain. (also ICNAF Res. Doc. 67/58)
- 67/6 Scottish salmon catch statistics. (also ICNAF Res. Doc. 67/60)
- 67/7 Scottish salmon tagging data, 1963-65. by DAFS, Pitlochry, Scotland. (also ICNAF Res. Doc. 67/61)
- 67/8 UK research program for Greenland salmon investigations, 1967. (also ICNAF Res. Doc. 67/62)
- 67/9 Distribution and characteristics of Atlantic salmon over oceanic depths and on the bank and shelf slope areas off Newfoundland, March-May 1966. by W. Templeman, (also ICNAF Res. Doc. 67/65)
- 67/10 The age composition of salmon from the Miramichi area, New Brunswick, Canada. by FRB Canada, St. Andrews, New Brunswick. (also ICNAF Res. Doc. 67/92)
- 67/11 A revised estimate of the rate of growth between Greenland and home waters of salmon from the Miramichi River, New Brunswick, Canada. by K. R. Allen. (also ICNAF Res. Doc. 67/93)
- 67/12 Canadian data on Atlantic salmon catches. (also ICNAF Res. Doc. 67/94)
- 67/13 Canadian tagging data for Atlantic salmon. (also ICNAF Res. Doc. 67/95)
- 67/14 Preliminary studies on the use of parasites of Atlantic salmon as a means of distinguishing between Eastern and Western Atlantic salmon stocks by John H. C. Pippy. (also ICNAF Res. Doc. 67/96)
- 67/15 Scottish biochemical studies on salmon. by N. P. Wilkins. (also ICNAF Res. Doc. 67/99)
- 67/16 Atlantic salmon tagging data for England and Wales. (also ICNAF Res. Doc. 67/100)
- 67/17 Statistics on landings of Atlantic salmon in Greenland in 1966. by J. M. Jensen. (also ICNAF Res. Doc. 67/102)
- 67/18 Salmon catches for England and Wales 1966, showing proportion of grilse in these catches. (also ICNAF Res. Doc. 67/103)
- 67/19 Canadian Atlantic salmon research program, 1967. by K. R. Allen. (also ICNAF Res. Doc. 67/105)
- 67/20 Results of Atlantic salmon tagging in the Maritime Provinces of Canada, 1964-1966. by K. R. Allen. (also ICNAF Res. Doc. 67/108)

- 68/1 The length, weight and age composition of the salmon catch from the river North Esk (Scotland) from 1962 to 1966. by W. M. Shearer. (also ICNAF Res. Doc. 68/31)
- 68/2 Salmon studies in Greenland - 1967. by W. R. Munro. (also ICNAF Res. Doc. 68/32)
- 68/3 The Norwegian statistics for the salmon and sea-trout fishery, 1876-1965, with some comments. by L. Rosseland. (also ICNAF Res. Doc. 68/33)
- 68/4 Scottish research program for Greenland investigations, 1968. by DAFS, Pitlochry and Aberdeen. (also ICNAF Res. Doc. 68/41)
- 68/5 Scottish salmon catch statistics. by W. R. Munro. (also ICNAF Res. Doc. 68/42)
- 68/6 Notes on the relationship between the West Greenland salmon fishery and salmon stocks in Scottish home waters. by DAFS, Pitlochry (also ICNAF Res. Doc. 68/43)
- 68/7 Canadian tagging data for Atlantic salmon to 29 March 1968. by FRB Canada, St. Andrews, New Brunswick. (also ICNAF Res. Doc. 68/44)
- 68/8 Scottish salmon tagging data, 1963-1966. by DAFS, Pitlochry. (also ICNAF Res. Doc. 68/45)
- 68/9 Studies on the parasites of Atlantic salmon (Salmo salar). by John H. C. Pippy. (also ICNAF Res. Doc. 68/46)
- 68/10 Some meristic and morphometric characters of salmon in Greenland waters. by Jens Møller Jensen. (also ICNAF Res. Doc. 68/55)
- 68/11 Statistics on landings of Atlantic salmon in Greenland, 1967. by Jens Møller Jensen. (also ICNAF Res. Doc. 68/56)
- 68/12 Canadian research cruise on salmon to West Greenland in 1967. by P. F. Elson. (also ICNAF Res. Doc. 68/63)
- 68/13 Report on recaptures in Greenland waters of salmon tagged in rivers in America and Europe, and of recaptures from tagging experiments in Greenland. by Jens Møller Jensen. (also ICNAF Res. Doc. 68/65)
- 68/14 Utilization of recaptured Canadian tagged salmon, 1964-1967. by P. F. Elson. (also ICNAF Res. Doc. 68/66)
- 68/15 Atlantic salmon recapture information for Maine-tagged fish. by R. E. Cutting and A. L. Meister. (also ICNAF Res. Doc. 68/72)
- 68/16 A proposed method of tabulating scale interpretations and age-classes of Atlantic salmon (Salmo salar L.). by A. L. Meister and R. E. Cutting. (also ICNAF Res. Doc. 68/73)
- 68/17 Preliminary report on catches of Atlantic salmon in the Labrador Sea, 29 March - 5 April 1968. by A. W. May. (also ICNAF Res. Doc. 68/77)
- 68/18 Salmon statistics, Scotland. by W. R. Munro, DAFS, Pitlochry. (also ICNAF Res. Doc. 68/78)
- 68/19 Salmon Statistics, England and Wales. by MAFF, London. (also ICNAF Res. Doc. 68/79)
- 68/20 Notes on investigations into Atlantic salmon racial polymorphism. by I. R. H. Allan, MAFF, London. (also ICNAF Res. Doc. 68/80)
- 68/21 Marine growth of Atlantic salmon (Salmo salar) in the Northwest Atlantic area. by K. R. Allen, R. L. Saunders and P. F. Elson, FRB Canada. (also ICNAF Res. Doc. 68/81)
- 68/22 Irish salmon data. by E. Twomey. (also ICNAF Res. Doc. 68/82)