RESTRICTED

INTERNATIONAL COMMISSION FOR THE NORTHWEST ATLANTIC FISHERIES

Serial No. 1856
(D.c.9)

ICNAF Res.Doc.67-65

ANNUAL MEETING - JUNE 1967

Distribution and characteristics of Atlantic salmon over oceanic depths and on the bank and shelf slope areas off Newfoundland, March-May, 1966

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Abstract

Between 21 March and 1 May 1966, 45 Atlantic salmon were caught in 8 surface drift-net night sets east and southeast of the Newfoundland area over depths greater than 1,800 m.

Some salmon were caught in all sets with surface temperatures between 3.7 and 6.1°C but none in a set on the eastern border of the area with a surface temperature of 9.2°C. The salmon were all captured in the upper 1.5 m of the nets.

Eighty-four per cent of the salmon were 2-sea-year fish and four had spawned previously. River life was mainly 2-4 years. Gutted weights were 89.7% of round weights.

In a comparison with salmon taken by the author in the Labrador Sea-West Greenland in July-August 1965 no distinct differences were noted in body proportions, and of the meristic characters only gill rakers and pectoral fin-ray numbers were significantly different. There were also some differences in parasitic infestations.

Food was 95% fish, the main diet being the paralepid, Paralepis coregonoides and lantern fish, especially Notoscopelus. There was less food in the stomachs than in the Labrador Sea-West Greenland salmon during July-August 1965 and much less than in salmon from the West Greenland banks in August 1965.

Contents

Introduction

In July-August 1965 (Templeman, 1967) salmon were caught from the A.T. Cameron by drift net over oceanic depths in the Labrador Sea.

Between 21 March and 1 May 1966, 7 surface drift-net night sets, each with 21-22 synthetic (mainly Ulstron) nets ranging from 83 to 89 mm mesh (1 to 2 nets only and not in all sets) and from 114 to 152 mm stretched mesh, were made in the Labrador Sea east of southern Labrador, east of the Northeast Newfoundland Shelf, and north of the Grand Bank and Flemish Cap, all over water deeper than 1,000 fathoms (1,800 m). A similar set was also made off the southwestern Grand Bank beyond the 1,000 fathom (1,800 m) isobath (Fig. 1). A preliminary brief account of this work was presented in Templeman (MS, 1966).

Materials and methods

The twine used, the methods of handling the nets and of examination were generally similar to those described in Templeman (1967), but in 1966 the fish were frozen at sea, thawed in flaked ice at the Biological Station several days to 2 weeks later and the final measurements, weights and detailed examinations were then carried out at the Station. Sea measurements and round weights were also taken. The numbers and the locations of attachment of the copepod, *Lepeophthirus salmonis* were observed at sea.

Standard lengths were taken on a measuring board from the anterior tip of the snout, with the mouth closed, to the posterior end of the hypurals as judged from the crease formed in the tail when the caudal fin was bent sharply upward.

Unless otherwise stated the lengths of salmon mentioned in this paper are fork lengths measured on a measuring board from the most anterior point, the snout with the mouth closed, to the posterior end of the mid-fork of the caudal fin.

Gutted weights were taken as in 1965 with all the viscera removed but with the gills remaining. The Toledo balance used was checked at intervals and was accurate to the nearest ounce or half-ounce.

Results

Fishing localities and catches

Forty-five salmon were caught (Fig. 1, Tables 1, 2). Some salmon were caught in all sets with surface temperatures between 3.7 and 6.1°C but none in a set on the eastern border of the area with a surface temperature of 9.2°C. The most northerly stations at the mid-mouth of the Labrador Sea were in the same general location where salmon were caught by the A.T. Cameron in July 1965 (Templeman, 1967). The greatest numbers of salmon were found closer to rather than more seaward from the 1,000 fathom (1,800 m) isobath. The salmon caught east of the Labrador Shelf in March were on the average larger than those caught off the Northeastern Newfoundland Shelf in April.

Location of salmon in net

The salmon were all captured in the upper 5 feet (1.5 m) of the nets of which 3 were 2.4-3.2 m and the remainder (18-19) were 4.4-5.0 m deep. Even in this upper 1.5 m most salmon were near the surface, the distribution of capture in each foot of the first 5 feet (1.5 m) from the surface being 16, 15, 5, 3, 3 respectively.

There was little evidence from the captures that the salmon were moving in close schools. The individuals of one pair were 3.7 m apart and the individuals of 2 pairs 5.5 m apart. The remaining spaces between pairs of individuals were approximately: 28 m (1), 31 m (2), 50 m (5), 80 m (3), 140 m (10), 240 m (5), 380 m (2), 530 m (4), and 690 m (2).

Comparative salmon catches in nets of different mesh sizes

No salmon were caught in the $3\frac{1}{2}$ inch (83 mm) mesh trout net nor in the $3\frac{1}{4}$ inch (89 mm) mesh mackerel net. The 5-6 inch (127-152 mm) mesh nets caught more salmon, larger salmon and a greater weight of salmon per net set than the $4\frac{1}{2}$ inch (114 mm) mesh nets (Table 3). The same number of $4\frac{1}{2}$ inch nets (12) was used at each set and approximately the same number (8-10) of 5-6 inch nets. The $3\frac{1}{4}$-$3\frac{1}{2}$ inch nets were 4.3 m deep. Ten of the $4\frac{1}{2}$ inch nets were 4.4 m deep and 2 were 3.2 m deep. Eight of the 5-$5\frac{1}{2}$ inch nets were 5.0 m deep, one $5\frac{1}{2}$ inch net was 4.6 m deep and the 6 inch net was 2.4 m deep. Since no salmon were caught in any net below 1.53 m it is unlikely that the comparative catches of the $4\frac{1}{2}$ inch and the larger mesh nets were greatly affected by differences in the depth of the nets.

Condition of salmon as taken from the net

Salmon taken by drift net were often in poor condition when taken on board the A.T. Cameron. The salmon of Fig. 2A and 2B were taken on board in a strong wind of about 55 km per hour and were dead and in poor condition with most of the scales absent by the time they came on board. They show severe net scars. Other fish were in better condition with regard to scale covering when captured (Fig. 2C, 3). In all cases the photographs were taken at the Biological Station after freezing and thawing the specimens and in addition the fish of Fig. 2A and 2B were gutted at sea and thus were in gutted condition when the photographs were taken. The larger fish were meshed more anteriorly and this often appeared to produce less serious net effects than when there was greater mesh penetration. Fish caught as far back as around the operculum, however, often had serious injuries dorsally through cutting by the meshes during struggles by the fish and retrieval of the net.

The March-May 1966 fish were generally in better condition on capture with better retention of scales than those of July-August 1965. It is possible that the fish caught in March-April 1966, being closer to entering the rivers for spawning, had a thicker epidermis, and that providing suitable methods of capture had been employed, tagging would have been more successful at this time than from the July-August 1965 captures, (in the Labrador Sea-West Greenland area) which were not so close to spawning. It is also possible that by 1966 the fishermen on the A.T. Cameron had learnt how to handle the drift nets better on recovery.

Male salmon for both periods (Fig. 2, 3) showed no apparent difference in anterior lower jaw development beyond that in the females.

Age and length

Most of the salmon (84%) were 2-sea-year fish (Fig. 1, Table 4). There were 9% 1-sea-year and 7% 3-sea-year fish. Two of the 2-sea-year and 2 of the 3-sea-year fish had spawned in their 1+ year as grilse. Fork lengths of the 1-sea-year fish ranged from 480 to 585 mm, of the 2-sea-year fish from 599 to 788 mm but mainly between 645 and 744 mm. The two 2-sea-year salmon which had spawned previously as grilse were toward the lower part of the length range of the 2-sea-year fish. Fork lengths of the 3-sea-year fish ranged from 710 to 874 mm, the single fish which had not spawned previously being considerably larger than the 2 which had spawned as grilse.

River life was 24% 2, 40% 3, 31% 4 and 4% 5 years.

There is a possibility that the growth of each sea year-group of salmon is affected adversely by the presence of tapeworms and by the quantity of tapeworms present (Table 5). Only the 2-sea-year group was numerous enough to be worthy of this comparison.

Length-weight

Whole weight (measured at the Station) increased from about 1.3 kg at 500 mm fork length to about 4.1 kg at 750 mm. The largest salmon, at 874 mm, weighed 7.7 kg (Fig. 4).

Three 1-sea-year fish ranged in round weight from 1.2 to 2.1 kg, 38 2-sea-year fish from 2.4 to 4.5 kg and three 3-sea-year fish (the 2 smaller spawning as grilse) from 3.5 to 7.7 kg. The average round weight of 44 salmon at sea immediately after capture, 3.31 kg, was only slightly higher than the weight at the Station, 3.27 kg.

In view of the small numbers and the considerable individual variation in weight, there are no great differences in weight in the places and times sampled but there is a weak tendency for most individuals caught in the Labrador Sea in March to be lower in weight. In the small numbers examined there are no obvious sex differences in weight. Three of 1-, 2- and 3-sea-year fish which spawned as grilse are close to or slightly above the average weight curve and the largest is below but not more so than some of the maiden fish.

Average gutted weights as percentages of whole weights for salmon of lengths to mid-fork in mm of 485-648, 650-679, 680-720, 721-788, and 721-874 were (no. fish in parentheses): 89.0(11), 88.8(11), 89.6(11), 91.2(10), 91.4(11), overall 89.7(44).

The weight curves are not greatly different from those for the 1965 Labrador Sea-West Greenland salmon (taken from Templeman, 1967, and superimposed in Fig. 4) but weights are higher at the smaller sizes for the 1966 salmon.

The presence of tapeworms in the pyloric caeca and intestine, and quantities of tapeworms as high as 38-49 cc per salmon did not have any noticeable effect on the salmon round or gutted weight relative to salmon of similar lengths with no tapeworms or with only small infestations.

Body proportions

Greatest length. The greatest length to the tip of the upper or the lower lobe of the caudal fin, extending directly backwards, declined from about 107.5% of the fork length at the smaller to about 106.5 at the larger sizes (Fig. 5A).

In 9 males and 19 females (total 28) the greatest length was to the tip of the upper caudal lobe; in 3 males and 3 females (total 6) the greatest lengths to the tips of the upper and of the lower caudal lobes were equal; and in 1 male and 6 females (total 7) the greatest length was to the tip of the lower caudal lobe. On the average the greatest length to the tip of the upper lobe in 41 fish was 0.27% greater in terms of total length to the mid-fork than that to the tip of the lower lobe.

Standard length. Standard length for 14 salmon 485-659 mm fork length was 91.0% of fork length, for 14 salmon 665-695 mm fork length it was 91.3% of fork length, and for 15 salmon 722-874 mm fork length it was 91.0% of the fork length. Overall for 43 fish the standard length was 91,1% of the total length to the mid-fork of the caudal fin. There was thus in these fish no change of relative standard length with increase in fork length, and plotting body proportions relative to fork length should on the average be approximately as suitable as plotting them against standard length. The policy of plotting them against fork length has been followed so that they may be compared with the data for 1965 (Templeman, 1967) for which no standard lengths are available.

Sea lengths and Station lengths. The fork length was measured on a measuring board to the nearest millimetre fresh at sea. The fish were frozen on board ship and measured on shore a few days to 2 weeks later after thawing in flaked ice. For 44 salmon, fork lengths measured at sea averaged 689.8 mm and on shore 681.5 mm.

Pectoral length. The pectoral length relative to the fork length (Fig. 5B) declines from about 13% at the smaller to about 12% at the larger fish lengths. In these small numbers there is no apparent difference between areas or sexes.

Head length. The trend in relative head length (Fig. 5C) with increasing fish length is uncertain. It may hold level at about 19% and on the average from these data head length is 18.8% fork length. The small number of fish from the southwestern slope of the Grand Bank are toward the lower part of the distribution of head length compared with the fish from the more northern areas.

Girth. There is no indication that greatest girth changes in relation to the fork length with increase in fish length (Fig. 6C). The opercular girths of the smaller fish are above the average (Fig. 6D) but this was not the case in the Labrador Sea and West Greenland fish (Templeman, 1967, fig. 6D). Hence with the small numbers available here it cannot be assumed that relative girth changes with fish length. The largest specimen of these data (Fig. 6C and D) as well as the two large specimens of 800 mm and over in the 1965 data (Templeman, 1967, fig. 6C and D) were well above the average in relative girth. Many other fishes increase in relative girth with length but the numbers of large fish here are too few to reach a conclusion.

The lowest girths were for salmon from the Labrador Sea 21-24 March, the next lowest from east of the Northeast Newfoundland Shelf and north of the Grand Bank 10-16 April and the highest from southwest of the Grand Bank, 30 April-1 May. The girths of females were slightly higher than those of males. Overall the opercular girth for 43 fish was 42.9% and the maximum girth 52.1% of the fork length (Table 6). With the small numbers of fish, all of these comparisons are presented to be compared with data of other investigators rather than to prove the statements regarding them. The small numbers in any length class and the possibility of changes in relative girths with increase in length do not make statistical comparisons worthwhile.

Average girths for salmon from the Labrador Sea-West Greenland for July-August 1965 (Table 6) were generally similar to those of March-May 1966 but again there was considerable difference between areas and times as shown in Table 6 and described and discussed by Templeman (1967).

A few fish (Fig. 6B) were caught close to their greatest girth and the greatest girth of several of the smaller fish was below the mesh circumference of the $5\frac{1}{2}$ inch (140 mm), and the 6 inch (152 mm) nets and thus could have passed through the meshes of these nets. The two smallest fish could probably have passed through the 5 inch (127 mm) meshes also (Fig. 6A).

Meristic characters

The numbers of salmon from the various areas are too small to make definite statements of differences in meristic characters. However, it is indicated (Table 7) that vertebral numbers, dorsal fin-ray and gill-raker counts may be lower in the fish from the southwestern slope of the Grand Bank than in those from the northern areas - off Labrador, east of the Northeast Newfoundland Shelf and north of the Grand Bank.

Sex ratio and stage of sexual maturity

Of the maiden fish, 68% of the total and 73% older than 1-sea-year were females.

All males were immature or (for the previously spent fish) in immature condition. Testes were pink or reddish pink, the volume of both testes ranging from 1 cc for the smallest fish to 3.7-4.5 cc for the largest.

All females were immature or (for the previously spent female) in immature condition, with egg diameters ranging from 0.8 to 1.5 mm (Fig. 7) and ovarian volumes from 7 to 39 cc (all except two, 7-18 cc). In most individuals, however, both eggs and ovaries were beginning to enlarge slightly.

The left ovary was the longer in 19 of 30 fish. In 11 fish the right ovary was the longer. In volume the left was greater in 16, in 7 the right was greater and in 7 both ovaries were approximately equal. The average ovarian length relative to fish length to the mid-fork, in 29 females, was 16.0% for the left and 15.0% for the right ovary. The average ovarian volume in 29 females was 7.9 cc for the left and 7.3 cc for the right ovary.

Food

Food in the stomachs was mainly (95%) fish, the most important being the paralepid, Paralepis coregonoides, and lantern fishes, especially Notoscopelus sp. and Lampanyctus sp. Noteworthy among the invertebrate food were small amounts of arctic squid, Gonatus fabricii; pelagic shrimp, Pasiphaea multidentata; pelagic amphipods, Parathemisto; and euphausiids (Table 8).

No very large fish or invertebrates were present in the stomachs, but there was a considerable range in food size. The largest fish were Paralepis coregonoides, usually 250-300 mm long, and secondly the lantern fishes, Lampanyctus, up to 136 mm in length, and Notoscopelus. Invertebrates as small as pelagic amphipods, Parathemisto, down to about 1 cm in length and 0.1 cc in volume were eaten in small numbers.

The intestines all contained mainly remains of small fish and were usually filled chiefly with bones of these fish of the same size found in the stomachs.

Parasites

Sea lice, Lepeophtheirus salmonis. These external copepods were present on 75% of 16 salmon from east of Hamilton Inlet Bank 21-24 March, on 77% of 22 salmon from east of the Northeast Newfoundland Shelf to Flemish Cap 28 March-16 April, and on 71% of 7 salmon from the SW slope of the Grand Bank 30 April-1 May. In the overall total they were present on 76% of 45 salmon and were mainly females with large egg sacs, but some males were present. The number of parasites ranged from 3.3 per salmon and 4.6 per infested salmon off the southwest Grand Bank to 5.8 per salmon and 7.7 per infested salmon in the Labrador Sea east of Hamilton Inlet Bank (Table 9).

Both in 1965 and 1966 these Lepeophtheirus copepods were most numerous on the body near the base of and immediately posterior to the anal fin (Fig. 8, 9). The remainder were mostly situated dorsally and mainly posterior to the greatest girth of the body which is near the anterior border of the dorsal fin.

Numbers of parasites and of fish parasitised, and distribution of the copepods are certainly minimal since some copepods would have been lost in the gill nets, especially from the part of the body anterior to the 1st dorsal.

Salmon gill-maggot, Salmincola salmonea. Gills of all salmon were examined for this parasite and only one was found, a normal sized female without egg sacs (length excluding maxillary arms 4.6 mm) on a male salmon 480 mm fork length with 1 year at sea and no indication of spawning marks. The parasite was attached to a gill filament on the anterior face of the lower limb of the first left branchial arch and at least 9 gill filaments in the vicinity of attachment had the distal two-thirds eaten away.

Eubothrium crassum. Seventy-one per cent of the 45 salmon possessed tapeworms, Eubothrium crassum in the pyloric caeca and intestines (Table 10). In the northern area east of Hamilton Inlet Bank, 56% of 16 salmon carried tapeworms. In the area somewhat farther south, from east of the Northeast Newfoundland Shelf to Flemish Cap, 83% of 22 salmon possessed tapeworms and southwest of the Grand Bank 71% of 7 salmon carried tapeworms. These numbers of salmon especially southwest of the Grand Bank are too small to provide more than an indication of the true percentage of infestation. The quantity of tapeworms present in a single fish ranged from 1 to 49 cc.

There is an indication also that more fish of the higher river ages carry tapeworms - 62% of 29 fish at 2-3 years river life and 88% of 16 fish at 4-5 years river life. There is, however, no indication that the amounts of tapeworms present (Table 10) increase with a longer period of river life.

Anisakis sp. Larval nematodes, Anisakis sp., encysted in flat circular coils on the liver, nearly always on its ventral surface, occurred in 33% of the salmon. The two northern areas had 31 and 32% of the 16 and 22 fish parasitised with Anisakis on the surface of the liver (range 0-1 and 0-2 and average 0.3 and 0.5 parasites per fish), and the southwestern Grand Bank area 43% of 7 fish parasitised (range 0-4 and average 1.0 Anisakis per fish). Because of the small numbers of fish these small differences between areas are unlikely to be important.

Discussion and conclusions

Distribution

The expanding salmon fishery in West Greenland, based on Canadian and European salmon (Hansen, 1965, 1967), shows that large numbers of salmon journey to West Greenland from these areas. Templeman (1967) showed the presence of salmon in the surface layers in July-August at the mid-mouth of the Labrador Sea, and west of Cape Farewell. The new investigations reported in this paper show that numerous salmon are present in March-April over oceanic depths east of the continental shelf and together with the July-August captures indicate that salmon live year round over the waters deeper than 1,800 m in the Labrador Sea. The moderately high surface temperatures (3.7 to 6.1°C) found in this March-April period, and presumably throughout the winter, enable the salmon to live close to the surface even in winter. Whereas in July-August 1965, salmon were present and sometimes relatively abundant at the mouth of the Labrador Sea and off Cape Farewell at temperatures of 8.5 to 8.6°C and fairly abundant at 9.6°C, in March-April 1966 they were most abundant at lower temperatures between 4.7 and 5.4°C. There is in this area, therefore, only a narrow annual range of surface temperatures, allowing the salmon, as is apparent from the scales, to have a slower but still significant amount of growth during the winter-early spring period.

The legal salmon fishing season on the east coast of Newfoundland begins on 15 May and some salmon strike the coast before this time. On the average the larger salmon approach the coast first and the grilse later. The catch of 7 salmon off the southwestern Grand Bank indicates that the slope water in the vicinity of 3 to 6°C between the warm Gulf Stream water and the colder bank water along the Newfoundland and Nova Scotian banks may be the winter abode of certain numbers and groups of salmon and may also form a winter-spring migration track of salmon from the northern eddy systems. It is also possible that many salmon may follow the intermediate temperature slope water into the Gulf of St. Lawrence or the Bay of Fundy without first approaching the nearest coast. It may be some of these salmon from the southwestern slope of the Grand Bank which begin to pass near the Port-aux-Basques and neighbouring areas of the western part of the south coast of Newfoundland and into the Gulf of St. Lawrence early in May.

As in the 1965 results (Templeman, 1967) the salmon at night were very close to the surface.

Sea age and spawning

Most of the West Greenland catch consists of 1+ sea-year salmon and the remainder 2+ or greater sea-year salmon. Thus most of the 2-sea-year salmon (84% of the total), and of the 3-sea-year (7%), and some of the 1-sea-year (9%) caught in the oceanic areas on 21 March-1 May 1966 were presumably those returning to the Canadian rivers for spawning.

Length-weight

The weak tendency in Fig. 4 for the Labrador Sea, 21-24 March individuals to be lower in weight is also reflected in the girths of these fish being lowest (Table 6). The amount of food in the stomach per kilogram of body weight was also lowest in these Labrador Sea salmon (Table 8) and temperatures in the upper 100 m are generally lower in the north (Table 2, Fig. 1). The small numbers of fish examined here, therefore, reflect the same tendency reported by Lindsay and Thompson (1932) that the yearly growth during the first and second years at sea of coastal salmon taken toward the north off St. Anthony, Newfoundland and Battle Harbour, Labrador was less than that of salmon taken farther southward off Bonavista and the Avalon Peninsula.

The gutted weights were 89.7% of the whole weight, very similar to the 88.7% for the Labrador Sea-West Greenland salmon (Templeman, 1967). This relationship is affected by the relative amounts of food present in the stomach and intestine and the amounts of fat on the viscera and will vary somewhat between areas and times even if the fish flesh is in equally as good condition.

There is an apparent contradiction in the small amount of data presented in that while no apparent relationship could be detected at neighbouring lengths between the presence or numbers of tapeworms and the fish weights, there is some evidence (Table 5) that the amount of growth in a sea year-group may be affected by the amounts of tapeworms present. The effects of the quantities of tapeworms present, on the growth and weight, are worth investigating further with larger numbers of salmon and, if possible, from fresh arrivals to the same river run.

Body proportions

In both the 1965 (Templeman, 1967) and the 1966 samples of salmon, with increase in total length to the mid-fork there is a small decrease in relative greatest length and in relative pectoral length. The relative proportions of these measurements and of the head length to the fork length appear to be approximately similar in the samples for both years.

Meristic characters. The salmon caught in March-May 1966 were relatively close to the Canadian area and almost all were 2-year fish and greater which make up only a very small proportion of the West Greenland landings. It can therefore be assumed that they were mainly Canadian fish. The samples obtained in July-August 1965 presumably contained mainly Canadian fish from the mid-mouth of the Labrador Sea and both European and Canadian fish in the larger part of the sample taken off West Greenland.

The probability values of a number of meristic characters for these 1965 and 1966 samples are compared in Table 11. The differences in vertebral averages and dorsal fin rays are not significant. The differences in the pectoral fin-ray averages are significant at less than the 5% level. The differences in averages both of total gill rakers on the 1st branchial arch and of those on the lower limb of the 1st branchial arch are highly significant. It would appear therefore that meristic characters are worth studying further as a means of showing differences between North American and European salmon. Actual differences may be greater than those shown here since the 1965 samples were almost certain to be of mixed North American and European origin.

The gill-raker numbers show the greatest difference, and our 1966 sample average for gill rakers on the 1st branchial arch (19.44) is between that of McCrimmon (1949) for presumably Canadian Atlantic salmon but of unidentified origin (average 19.8 for 41 specimens) and that of Wilder (1947) from Canadian rivers of the Maritimes and Quebec (average 18.8 for 28 adult salmon).

If the Labrador Sea data are removed from the 1965 samples leaving only the West Greenland related data the probability of the differences in the 1965 and the 1966 pectoral fin-ray averages being significant is not improved (Table 11). The 1965 vertebral average is now below that of 1966 but the differences between vertebral averages still do not approach significance. For other meristic data, inspection of the original 1965 frequencies in Templeman (1967) and of the 1966 frequencies in Table 6 indicates that removal of the 1965 Labrador Sea data would have little influence on the "t" and probability values.

Food

Total stomach contents per kilogram of salmon round weight (4.7 cc) in the March-May salmon (Table 8) were only half ~~that~~ those in Labrador Sea-West Greenland July-August 1965 fish (9.6 cc) and still less than the amounts per kg of salmon weight on the West Greenland banks in August 1966 (15.9 cc) (Templeman, 1967).

In both the 1965 and the 1966 salmon the main diet was fish but lantern fish were not noted in the summer diet, and squid, Gonatus fabricii, were more important to the oceanic salmon in July-August 1965 than in March-April 1966. By the latter period most of the young Gonatus hatched early in the previous year had grown large enough to lie deeper as do the adults, and the new larvae of the year were not large enough to be attractive as food except on a minor scale. In plankton tows in the upper 50 m in March 1966 at the mouth of the Labrador Sea, these Gonatus larvae were fairly numerous and were about 1 cm and less in mantle length.

Parasites

Lepeophtheirus salmonis. The infestation rate of 76% on the salmon taken in April-May 1966 is similar to the 70% infestation on 10 salmon from the Labrador Sea and considerably lower than the 93% infestation on 28 salmon from the West Greenland banks and off Cape Farewell and Cape Desolation in July-August 1965 (Templeman, 1967). This may mean that more European than Canadian salmon are infested with these parasites, but under the conditions of capture the possibilities of loss of these parasites and of variations in this loss were great.

Salmincola salmonea. Friend (1941) from observations on salmon in Scottish rivers says that fresh-run maiden salmon are never seen with obvious maggots on their gills. Six previously spawned salmon taken in nets near the Scottish Coast all had female gill-maggots without egg sacs, 4-75 mature-sized gill-maggots per fish. Estuarine previously spawned fish returning from the sea also carry mature-sized female gill-maggots but none of them have egg sacs. Immature river fish, up to and including the smolt stage, have not been found to possess gill-maggots. Infection of returning maiden fish and reinfection of returning previously spawned fish occurs in the river or estuary.

In our investigations none of these salmon maggots were found on the gills of 4 salmon which had spawned previously. The presence of an adult female parasite of this species on a male salmon with only 1 sea year which showed no evidence of spawning unless it spawned as a parr, appears to be unusual.

Eubothrium crassum. The 71% of the 45 March-May 1966 salmon infested with this tapeworm is similar to the 60% with tapeworms of 10 salmon from the Labrador Sea in July-August 1965 and different from the 21% with tapeworms of 28 salmon from the West Greenland banks and west of Cape Farewell and Cape Desolation in August 1965 (Templeman, 1967). This suggests that less European salmon in the West Greenland area may have tapeworms.

As in the 1965 data there is an indication that the percentage of salmon infested with tapeworms may increase with length of river life. The differences in this regard for the 1966 data, however, are less than in those of 1965 where the salmon closer to the European area dominated at the lower ages and also had fewer tapeworms. Because the quantities of tapeworms present in the 1966 samples (Table 10) did not increase with length of river life too much confidence should not be placed on the relationships with river age in the number infested with these parasites.

Anisakis sp. The percentage of salmon caught in March-May 1966 carrying this nematode on the ventral surface of the liver (33%) was considerably less and the average number of nematodes per fish (0.5) was less than in salmon from any area in July-August 1965 - 56% of 9 salmon (average 0.8 nematodes) from the Labrador Sea, 54% of 13 salmon (average 1.2 nematodes) from the West Greenland banks, and 73% of 15 salmon (average 2.2 nematodes) from west of Cape Farewell and Cape Desolation (Templeman, 1967). It is possible that the numbers may be too small for adequate comparison or that European salmon in the West Greenland area have higher numbers of this parasite. The 1966 salmon were frozen and then thawed before examination whereas the 1965 ones were examined fresh and it is possible, although unlikely, that the freezing and thawing loosened and displaced some of these small parasites so that they were not noted.

Acknowledgements

I am grateful to Messrs R. Wells, E. M. LeGrow, C. I. Barbour scientist- and technicians-in-charge of the *A.T. Cameron* cruises in which these salmon were caught, also to Mr M. C. Mercer and Dr H. J. Squires of the Biological Station staff, Dr D. H. Steele of the Biology Department of the Memorial University of Newfoundland, and Dr W. B. Scott and Mrs Isobel Radforth of the Royal Ontario Museum for advice regarding the food species. Messrs E. L. Rowe and R. J. Tizzard were responsible for the photographs.

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Table 1. Position of salmon surface drift-net sets, gear used and time of sets by the <u>A.T. Cameron</u>, 21 March-1 May 1966.

Date 1966	Position Lat. N	Position Long. W	No. of linear m of gill nets used 3¼-3½ inches (83-89 mm)	No. of sq. m of gill nets used 3¼-3½ inches (83-89 mm)	No. of linear m of gill nets used 4½-6 inches (114-152 mm)	No. of sq. m of gill nets used 4½-6 inches (114-152 mm)	No. of linear m of gill nets used 3¼-6 inches (83-152 mm)	No. of sq. m of gill nets used 3¼-6 inches (83-152 mm)	Nfld. Standard Time: Beginning of set	Nfld. Standard Time: Beginning of haul	Nfld. Standard Time: End of haul	No. minutes between setting and beginning of haul	Distance from nearest Newfoundland or Labrador coast in nautical miles
21-22 Mar.	55°29'00"	47°07'30"	181	773	1,720	7,802	1,901	8,575	1700	0530	0720	750	325
22-23 Mar.	55°30'00"	47°08'00"	181	773	1,720	7,802	1,901	8,575	2045	0530	0650	525	324
23-24 Mar.	54°14'30"	49°20'00"	181	773	1,720	7,802	1,901	8,575	1730	0820	1000	890	230
25-26 Mar.	52°16'50"	43°22'20"	181	773	1,720	7,802	1,901	8,575	1715	0530	0645	735	405
28-29 Mar.	49°04'00"	44°30'00"	181	773	1,720	7,802	1,901	8,575	1725	0500	0645	695	345
10-11 Apr.	48°50'00"	48°14'00"	84	359	1,808	7,982	1,893	8,341	1710	0600	0715	770	185
15-16 Apr.	50°58'00"	49°00'00"	0	0	1,895	8,377	1,895	8,377	1830	0500	0600	630	205
30 Apr.-1 May	43°15'00"	52°45'00"	0	0	1,895	8,377	1,895	8,377	1845	0530	0645	645	205

Table 2. Numbers and weights of Atlantic salmon caught in surface drift-net sets at and above various temperatures by the A.T. Cameron, 21 March-1 May 1966. (See Fig. 1 and Table 1 for positions, and Table 1 for number and mesh sizes of nets used and details of time of set.)

Date 1966	Locality	Depth at position	Temperature °C Surface	5 m	25 m	50 m	100 m	Salmon caught	Total weight of salmon caught
		m						No.	kg
21-22 Mar.	Labrador Sea	3,060	3.7	3.7	3.7	3.7	3.7	2	9.0
22-23 Mar.	Labrador Sea	3,200	3.8	3.8	3.8	3.8	3.8	4	11.5
23-24 Mar.	Labrador Sea	3,660	4.7	4.7	4.7	4.7	4.6	10	36.3
25-26 Mar.	N of Flemish Cap	3,840	9.2	9.2	9.1	9.0	8.6	0	0
28-29 Mar.	N slope of Flemish Cap	2,200	6.1	6.1	5.5	5.1	5.0	2	6.9
10-11 Apr.	N of Grand Bank	2,150	3.7	3.7	4.1	4.4	3.9	7	25.2
15-16 Apr.	E of NE Nfld. Shelf	2,130	5.3	5.3	5.4	5.4	5.1	13	33.8
30 Apr.-1 May	Off Southwest Grand Bank	2,710	5.2	5.2	4.9	4.8	5.7	7	24.7

Table 3. Catch of Atlantic salmon east and southeast of the Newfoundland area, 21 March-1 May 1966 by nets of various mesh sizes.(No. of nets and No. of salmon in parentheses. Weights are whole sea weights in kg. The set where no salmon were caught is not included. One net for 1 set = 1 net set.)

Weight and number of salmon caught	$3\frac{1}{4}$-$3\frac{1}{2}$ inches (83-89 mm)	$4\frac{1}{2}$ inches (114 mm)	5 inches (127 mm)	$5\frac{1}{4}$ inches (133 mm)	$5\frac{1}{2}$ inches (140 mm)	6 inches (152 mm)
Total salmon, kg (No. salmon)	0	66.0(23)	32.1(8)	7.6(2)	29.0(9)	3.4(1)
Weight of 1 salmon, kg	...	2.9(23)	4.1(8)	3.8(2)	3.2(9)	3.4(1)
Weight of 1 salmon, kg (combining 5-6 inch nets)	...	2.9(23)	...	3.6(20)		...
No. of salmon per net set (No. net sets)	...	0.27(84)	...	0.33(61)		...
Salmon per net set, kg (No. net sets)	0(9)	0.79(84)	1.28(25)	1.07(7)	1.12(26)	1.13(3)
Salmon per net set, kg (combining 5-6 inch nets)	0(9)	0.79(84)	...	1.18(61)		...

Table 4. Numbers, river and sea ages and lengths of Atlantic salmon caught by the A.T. Cameron east and southeast of Newfoundland, 21 March-1 May 1966. (M = male, F = female, * = spawned at 1+ sea years.)

Date 1966	Locality	No. of salmon at river ages (years)				No. of salmon at sea ages (years): Maiden fish						Fish with 1 spawning mark				No. of salmon at total lengths to end of mid-fork of caudal (cm): 1 sea year			2 sea years				3 sea years				Total
						1+		2+		3+		2+		3+													
		2	3	4	5	M	F	M	F	M	F	M	F	M	F	45-49	50-54	55-59	60-64	65-69	70-74	75-79	70-74	75-79	80-84	85-89	
21-24 Mar.	Labrador Sea E of Hamilton Inlet Bank	5	7	3	1	...	1	5	8	...	1	...	...	1	...	...	...	1	2	4	6	1	...	1*	...	1	16
28-29 Mar.	N slope Flemish Cap	1	...	1	...	...	...	...	1	...	...	...	...	1	...	...	...	...	...	1	...	...	1*	...	...	...	2
10-16 Apr.	E of NE Nfld. Shelf and N of Grand Bank	2	10	7	1	3	...	5	12	...	...	...	...	...	...	2	1	...	2	10	5	...	...	...	...	...	20
30 Apr.-1 May	SW slope Grand Bank	3	1	3	...	...	...	...	5	...	...	...	2	...	...	...	...	...	1(1)*	1*	3	1	...	...	...	...	7
Total		11	18	14	2	3	1	10	26	...	1	...	2	2	...	2	1	1	5(1)*	15(1)*	14	2	1*	1*	...	1	45

Table 5. Relation of length of Atlantic salmon with 2 sea-years, caught by the A.T. Cameron east and southeast of the Newfoundland area 21 March-1 May 1966, to volumes of tapeworms in pyloric caeca and intestine. (* = spawned at 1+ years.)

Fork length of salmon	Quantities of tapeworms present (in order of increasing length of salmon with 2 sea years)	Total salmon with tapeworms	Total salmon	Average volume tapeworms per salmon	Average volume tapeworms per kg salmon gutted weight
mm	cc	No.	No.	cc	cc
599-650	14, 33*, 9.5, 26, 22, 7, 30, 23*, 24	9	9	20.9	8.6
651-679	26, 6.5, 20.5, 41, 25, 39, 9, 0, 2, 49	9	10	21.8	8.1
680-720	5.5, 7, 0, 0, 10, 10, 32.5, 9, 22, 25	8	10	12.1	4.1
721-788	22, 38, 0, 0, 0, 0, 34, 0, 0	3	9	10.4	3.1

Table 6. Atlantic salmon 1965-66 - opercular girth and greatest girth as percentages of total length to end of mid-fork of the caudal fin (No. of fish in parentheses).

	Average of per cent opercular girth of fork length			Average of per cent greatest girth of fork length		
	Male	Female	Total	Male	Female	Total
Labrado. .ea, 21-24 Mar. 1966	41.9(6)	42.4(9)	42.2(15)	51.2(6)	50.4(9)	50.7(15)
Flemish Cap, 28-29 Mar. 1966	43.4(1)	44.3(1)	43.9(2)	52.1(1)	56.0(1)	54.1(2)
E of NE Nfld. Shelf and N of the Grand Bank, 10-16 Apr. 1966	42.7(7)	42.9(12)	42.9(19)	51.3(7)	52.4(12)	52.0(19)
SW Grand Bank, 30 Apr.-1 May 1966	...	44.1(7)	44.1(7)	...	54.9(7)	54.9(7)
Labrador Sea, 19-20 July 1965	41.1(3)	43.0(2)	41.8(5)	47.8(3)	52.7(2)	49.7(5)
W Greenland banks, 5-16 Aug. 1965	44.0(5)	43.5(8)	43.7(13)	53.9(5)	54.9(8)	54.5(13)
W of C. Farewell and C. Desolation, 21-22 Aug. 1965	41.3(4)	41.5(11)	41.5(15)	50.2(4)	50.9(11)	50.7(15)
Labrador Sea, 22-23 Aug. 1965	44.3(1)	43.4(2)	43.7(3)	56.3(1)	54.4(2)	55.0(3)
Total: 21 Mar.-1 May 1966	42.4(14)	43.1(29)	42.9(43)	51.3(14)	52.5(29)	52.1(43)
Total: 19 July-23 Aug. 1965	42.5(13)	42.5(23)	42.5(36)	51.5(13)	52.8(23)	52.3(36)

Table 7. Meristic characters of Atlantic salmon east and southeast of Newfoundland, 21 March-1 May 1966.

Years of river life	2				3				4-5				Total 2-5			
Vertebral numbers	58	59	60	61	58	59	60	61	58	59	60	61	58	59	60	61
1. Labrador Sea E of Hamilton Inlet Bank	...	3	2	...	...	4	2	1	...	2	...	2	...	9	4	3
2. N slope of Flemish Cap	...	1	...	...	...	...	...	...	...	1	...	...	...	2	...	...
3. E of NE Nfld. Shelf and N of Grand Bank	...	...	1	1	1	2	6	...	1	3	2	2	2	5	9	3
4. SW slope Grand Bank	1	1	1	...	...	...	1	...	...	3	...	...	1	4	2	...
Total	1	5	4	1	1	6	9	1	1	9	2	4	3	20	15	6
Dorsal fin rays	14	15	16	17	14	15	16	17	14	15	16	17	14	15	16	17
1. Labrador Sea E of Hamilton Inlet Bank	2	3	...	...	1	3	2	1	1	3	...	...	4	9	2	1
2. N slope of Flemish Cap	1	...	...	...	...	...	...	...	...	1	...	...	1	1	...	...
3. E of NE Nfld. Shelf and N of Grand Bank	1	...	1	...	1	6	3	...	2	4	2	...	4	10	6	...
4. SW slope Grand Bank	2	1	...	...	...	1	...	...	1	2	...	...	3	4	...	...
Total	6	4	1	...	2	10	5	1	4	10	2	...	12	24	8	1

Anal fin rays	11	12	13	11	12	13	11	12	13	11	12	13
1. Labrador Sea E of Hamilton Inlet Bank	...	3	2	1	4	2	...	3	1	1	10	5
2. N slope of Flemish Cap	...	...	1	...	...	...	...	...	1	...	...	2
3. E of NE Nfld. Shelf and N of Grand Bank	1	1	...	1	6	3	...	6	2	2	13	5
4. SW slope Grand Bank	...	2	1	1	...	...	...	2	1	1	4	2
Total	1	6	4	3	10	5	...	11	5	4	27	14

(continued over-leaf)

Table 7 (cont.)

Pectoral fin rays	13	14	15	13	14	15	13	14	15	13	14	15
1. Labrador Sea E of Hamilton Inlet Bank	2	2	1	...	6	1	...	4	...	2	12	2
2. N slope of Flemish Cap	...	1	...	...	...	...	...	1	...	...	2	...
3. E of NE Nfld. Shelf and N of Grand Bank	1	1	...	1	7	2	...	7	1	2	15	3
4. SW slope Grand Bank	...	2	1	...	...	1	...	1	2	...	3	4
Total	3	6	2	1	13	4	...	13	3	4	32	9

Gill rakers 1st arch	17	18	19	20	21	22	17	18	19	20	21	22	17	18	19	20	21	22	17	18	19	20	21	22
1. Labrador Sea E of Hamilton Inlet Bank	...	...	...	2	2	1	...	...	3	3	...	1	...	1	1	1	1	...	...	1	4	6	3	2
2. N slope of Flemish Cap	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	1	...	...	...	1	...	1	...	...
3. E of NE Nfld. Shelf and N of Grand Bank	...	...	2	...	...	...	1	1	6	2	...	...	...	1	1	4	2	...	1	2	9	6	2	...
4. SW slope Grand Bank	...	1	2	...	...	...	...	1	...	...	...	...	1	...	1	1	...	...	1	2	3	1	...	...
Total	...	2	4	2	2	1	1	2	9	5	...	1	1	2	3	7	3	...	2	6	16	14	5	2

Gill rakers lower limb 1st arch	10	11	12	13	10	11	12	13	10	11	12	13	10	11	12	13
1. Labrador Sea E of Hamilton Inlet Bank	...	...	2	3	...	1	5	1	...	1	2	1	...	2	9	5
2. N slope of Flemish Cap	...	1	...	...	...	...	...	...	...	...	1	...	...	1	1	...
3. E of NE Nfld. Shelf and N of Grand Bank	...	2	...	...	...	2	7	1	...	1	6	1	...	5	13	2
4. SW slope Grand Bank	1	1	1	...	...	1	...	...	1	1	1	...	2	3	2	...
Total	1	4	3	3	...	4	12	2	1	3	10	2	2	11	25	7

21 March-1 May 1966. (Numbers of food individuals in parentheses. Portions only were sometimes present but were counted when they represented individual organisms.)

	Labrador Sea, E of Hamilton Inlet Bank	North slope of Flemish Cap	E of NE Nfld. Shelf and N of Grand Bank	SW slope of Grand Bank	Total
Date: 1966	21-24 Mar.	28-29 Mar.	10-16 Apr.	30 Apr.-1 May	21 Mar.-1 May
Depth to bottom: m	3,060-3,660	2,200	2,130-2,150	2,710	2,130-3,660
No. salmon stomachs with contents below:					
Empty	2	...	3	1	6
Arctic squid (*Gonatus fabricii*)	3	...	1	...	4
Part of arm of squid (*Histioteuthis* sp.)	...	...	...	1	1
Piece of squid pen	...	...	1	...	1
Amphipod (*Eurythenes* sp.)	1	...	...	...	1
Pelagic amphipod (*Parathemisto abyssorum*)	...	...	1	...	1
Pelagic amphipod (*Parathemisto gaudichaudi*)	1	...	1	...	2
Pelagic amphipod (*Parathemisto libellula*)	...	...	2	...	2
Pelagic amphipod (*Parathemisto* sp.)	2	...	4	...	6
Euphausiid (*Meganyctiphanes norvegica*)	...	...	1	...	1
Euphausiid	1	...	2	...	3
Pelagic shrimp (*Pasiphaea multidentata*)	1	...	1	...	2
Shrimp	1	...	...	...	1
Paralepis coregonoides	1	1	7	2	11
Lantern fish (*Benthosema glaciale*)	2	...	...	...	2
Lantern fish (*Hierops arctica*)	...	...	1	...	1
Lantern fish (*Lampanyctus* sp.)	...	...	2	...	2
Lantern fish (*Notoscopelus* sp.)	4	1	1	...	6
Lantern fish	...	1	2	1	4
Launce (*Ammodytes* sp.)	...	...	...	1	1
Pelagic fish (*Bathylagus* sp.?)	...	...	1	...	1
Pelagic fish	3	...	...	...	3
Fish fragments	3	1	6	2	12
No. salmon intestines with contents below:					
Intestine containing bones of small fish, mainly vertebrae with so[illegible] otoliths and jaw bones, scales, etc.	16	2	20	7	45

Table 8 (cont.)

Total quantity cc in stomachs (No. of individuals):					
Arctic squid (Gonatus fabricii)	16.3(4)	...	1.5(2)	...	17.8(6)
Part of arm of squid (Histioteuthis sp.)	...	...	...	2.0(1)	2.0(1)
Piece of squid pen	...	...	0.1(1)	...	0.1(1)
Amphipod (Eurythenes sp.)	0.1(1)	...	...	...	0.1(1)
Pelagic amphipod (Parathemisto abyssorum)	...	...	0.1(1)	...	0.1(1)
Pelagic amphipod (Parathemisto gaudichaudi)	0.1(1)	...	0.1(2)	...	0.2(3)
Pelagic amphipod (Parathemisto libellula)	...	...	0.1(2)	...	0.1(2)
Pelagic amphipod (Parathemisto sp.)	0.8(8)	...	0.8(8)	...	1.6(16)
Euphausiid (Meganyctiphanes norvegica)	...	...	0.3(1)	...	0.3(1)
Euphausiid	0.7(2)	...	0.4(2)	...	1.1(4)
Pelagic shrimp (Pasiphaea multidentata)	5.0(1)	...	2.0(1)	...	7.0(2)
Shrimp	1.0(1)	...	...	...	1.0(1)
Paralepis coregonoides	42.0(1)	30.0(1)	251.2(10)	53.0(2)	376.2(14)
Lantern fish (Benthosema glaciale)	7.5(3)	...	...	...	7.5(3)
Lantern fish (Hierops arctica)	...	...	1.5(1)	...	1.5(1)
Lantern fish (Lampanyctus sp.)	...	...	46.0(3)	...	46.0(3)
Lantern fish (Notoscopelus sp.)	62.8(9)	25.0(6)	24.0(4)	...	111.8(19)
Lantern fish	...	2.0(1)	16.0	15.0(1)	33.0
Launce (Ammodytes sp.)	...	...	...	11.0(1)	11.0(1)
Pelagic fish (Bathylagus sp.?)	...	...	11.0(1)	...	11.0(1)
Pelagic fish	27.8(3)	...	...	...	27.8(3)
Fish fragments	4.5	0.2	16.6	10.0	31.3
Total salmon stomachs examined, no.	16	2	20	7	45
Total round weight of salmon whose stomachs were examined, kg	56.5	6.8	57.5	24.3	145.1
Total fish in stomachs, cc	144.6	57.2	366.3	89.0	657.1
Total invertebrates in stomachs, cc	24.0	0	5.4	2.0	31.4
Total food in stomachs, cc	168.6	57.2	371.7	91.0	688.5
Total food, cc, per kg of salmon round weight	3.0	8.4	6.5	3.7	4.7

Table 9. Number of external copepods, *Lepeophtheirus salmonis*, on Atlantic salmon from east and southeast of the Newfoundland area, 21 March-1 May 1966.

Locality and date of capture, 1966	Total salmon	Salmon containing *L. salmonis*	*L. salmonis*	(a) *L. salmonis* per salmon with these parasites	(b) *L. salmonis* per salmon
	No.	No.	No.	No.	No.
Labrador Sea, E of Hamilton Inlet Bank (21-24 Mar.)	16	12	92	7.7	5.8
E of NE Nfld. Shelf, N of Grand Bank and N of Flemish Cap (28 Mar.-16 Apr.)	22	17	102	6.0	4.6
SW slope of Grand Bank (30 Apr.-1 May)	7	5	23	4.6	3.3
Total all areas	45	34	217	6.4	4.8

Table 10. Presence or absence of tapeworms, Eubothrium crassum, in Atlantic salmon from east and southeast of Newfoundland, 21 March-1 May 1966 (No. of salmon in parentheses).

Years river life	Labrador Sea, E of Hamilton Inlet Bank 21-24 Mar. — Average amount of tapeworms: Per salmon with tapeworms	Per salmon	E of NE Shelf, N of Grand Bank & N of Flemish Cap 28 Mar.-16 Apr. — Average amount of tapeworms: Per salmon with tapeworms	Per salmon	SW Slope Grand Bank 30 Apr.-1 May — Average amount of tapeworms: Per salmon with tapeworms	Per salmon	Total — Average amount of tapeworms: Per salmon with tapeworms	Per salmon	Per cent with tapeworms
	cc	cc	cc	cc	cc	cc	cc	cc	%
2	17.3(2)	6.9(5)	30.0(3)	30.0(3)	26.0(2)	18.7(3)	25.8(7)	16.4(11)	64
3	23.3(3)	10.0(7)	21.6(7)	15.1(10)	9.5(1)	9.5(1)	21.0(11)	12.8(18)	61
4	11.5(3)	11.5(3)	13.4(7)	11.7(8)	31.5(2)	21.0(3)	15.9(12)	13.6(14)	86
5	20.5(1)	20.5(1)	10.0(1)	10.0(1)	...(0)	...(0)	15.3(2)	15.3(2)	100
4 + 5	13.8(4)	13.8(4)	12.9(8)	11.5(9)	31.5(2)	21.0(3)	15.8(14)	13.8(16)	88
Total 2-5	17.7(9)	10.0(16)	19.1(18)	15.7(22)	25.7(5)	18.4(7)	19.8(32)	14.1(45)	71

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Table 11. Comparison of meristic characters of Atlantic salmon from the Labrador and West Greenland area, July-August 1965, and from the areas closer to Newfoundland included in the present paper, March-May 1966. (The 1965 data are calculated from Templeman (1967, table 5) and the 1966 data from the present paper (Table 7). [a] = 1965 values from West Greenland banks and off Cape Farewell and Cape Desolation only.)

Meristic character	No. of individuals		Mean		Standard deviation		Values of "t"	Probability
	1965	1966	1965	1966	1965	1966		
Vertebrae	37	44	59.62	59.55	0.59	0.82	0.43	0.7
Dorsal fin rays	38	45	15.03	14.96	0.63	0.73	0.46	0.7
Anal fin rays	38	45	11.97	12.22	0.63	0.60	1.84	>0.05
Pectoral fin rays	38	45	13.82	14.11	0.66	0.53	2.24	<0.05
Gill rakers on 1st branchial arch	37	45	21.00	19.44	1.51	1.14	5.33	<0.001
Gill rakers on lower limb of 1st branchial arch	37	45	12.54	11.82	0.90	0.75	3.96	<0.001
Vertebrae[a]	27	44	59.48	59.55	0.34	0.82	0.43	0.7
Pectoral fin rays[a]	28	45	13.79	14.11	0.74	0.53	2.15	<0.05

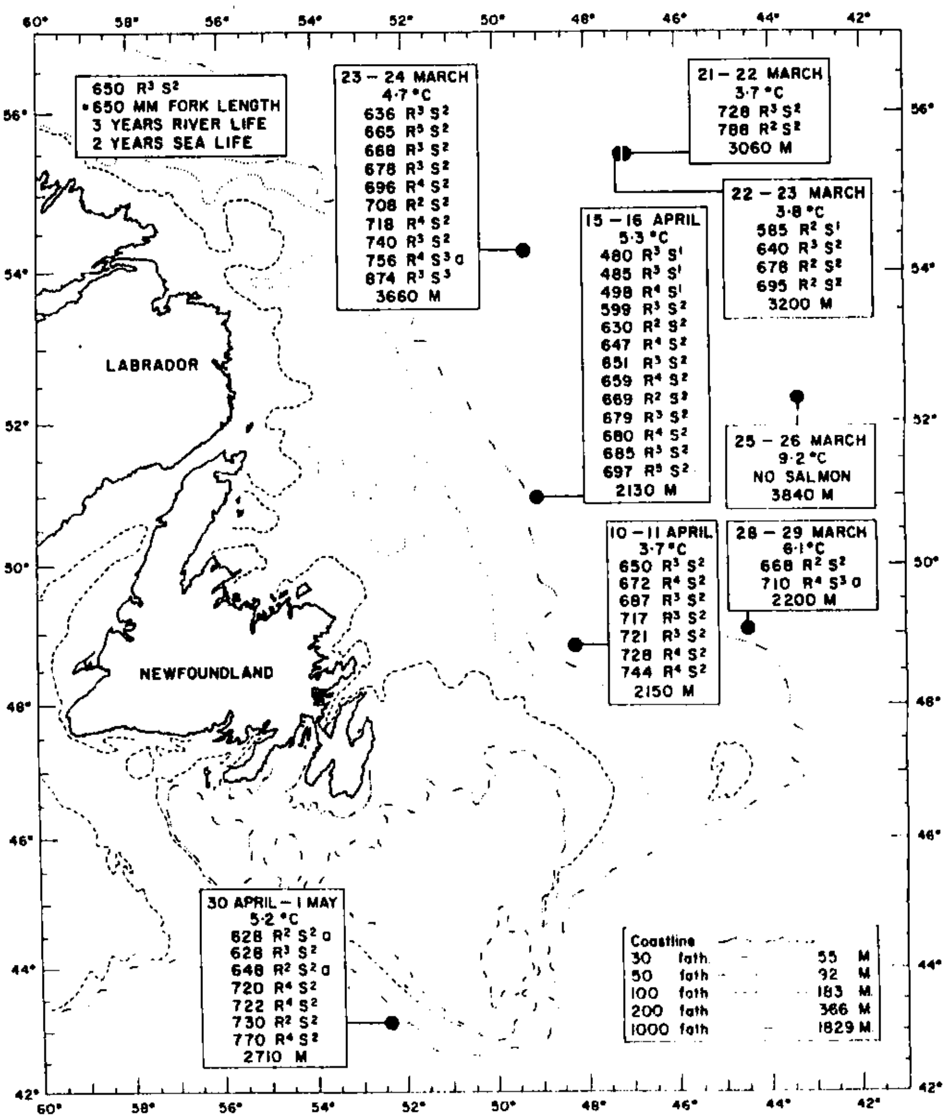

Fig. 1. Numbers, fork lengths (cm), river and sea life of Atlantic salmon caught in surface drift nets in night sets by the A.T. Cameron, 21 March-1 May 1966 at the positions, dates and surface temperatures indicated. (a = spawned at 1+ sea years.)

Fig. 2. Atlantic salmon taken by the <u>A.T. Cameron</u> in surface drift nets in the Labrador Sea, 18-19 July, 1965 (A and B) and (C) west of Cape Farewell 21-22 August, 1965: A, 600 mm fork length, female immature, 2.0 kg round weight, sea age 1+ years; B, 540 mm fork length, male immature, 1.4 kg round weight, sea age 1+ years; C, 707 mm fork length, female immature, 4.1 kg round weight, sea age 1+ years.

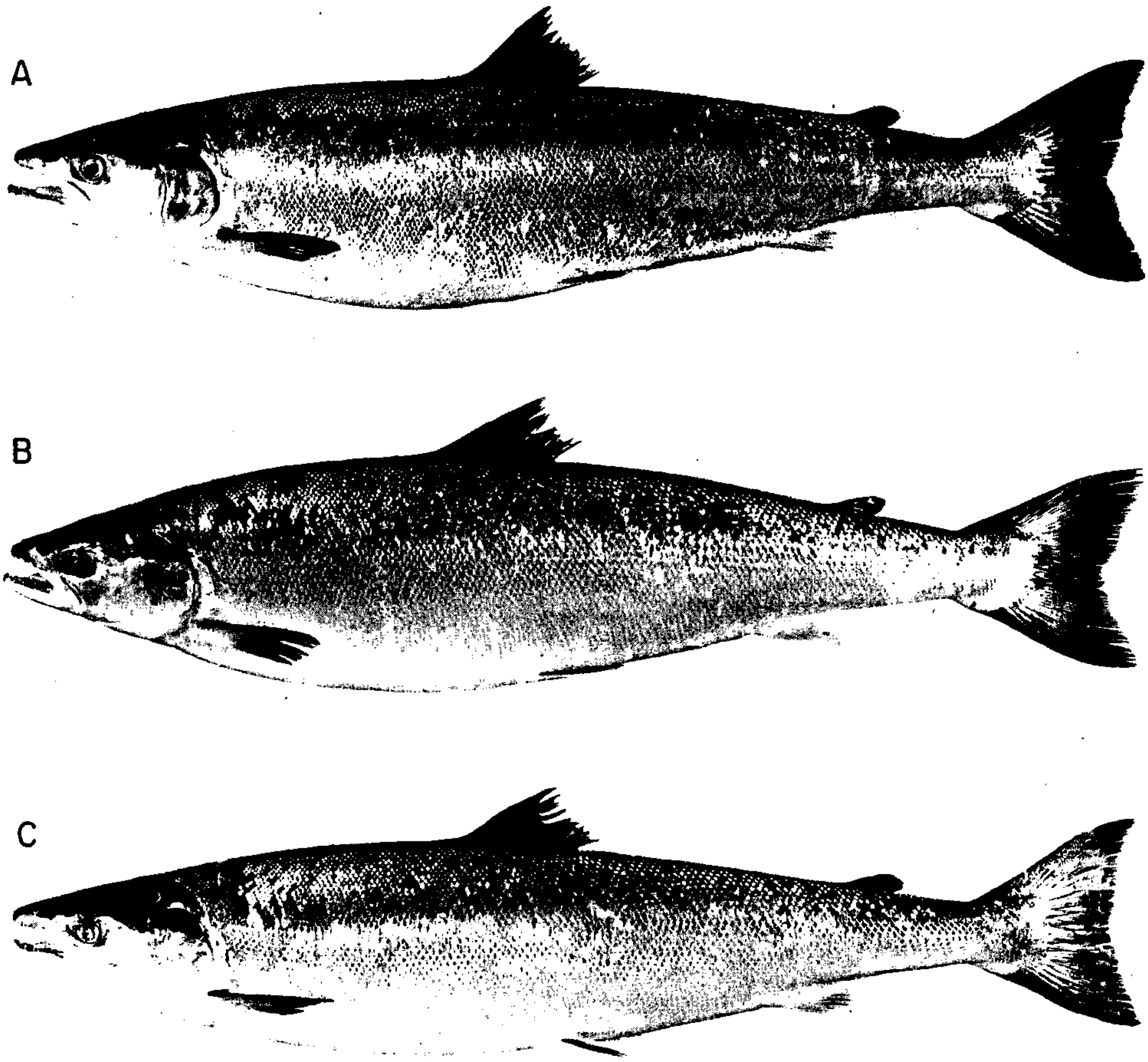

Fig. 3. Atlantic salmon taken by the A.T. Cameron in surface drift nets in the Labrador Sea, 23 March 1966: A, 668 mm fork length, male immature, 2.8 kg round weight, sea age 2+ years; B, 718 mm fork length, male immature, 3.8 kg round weight, sea age 2+ years; C, 756 mm fork length, male spawned at 1+ sea years and now in immature condition, 3.7 kg round weight, sea age 3+ years.

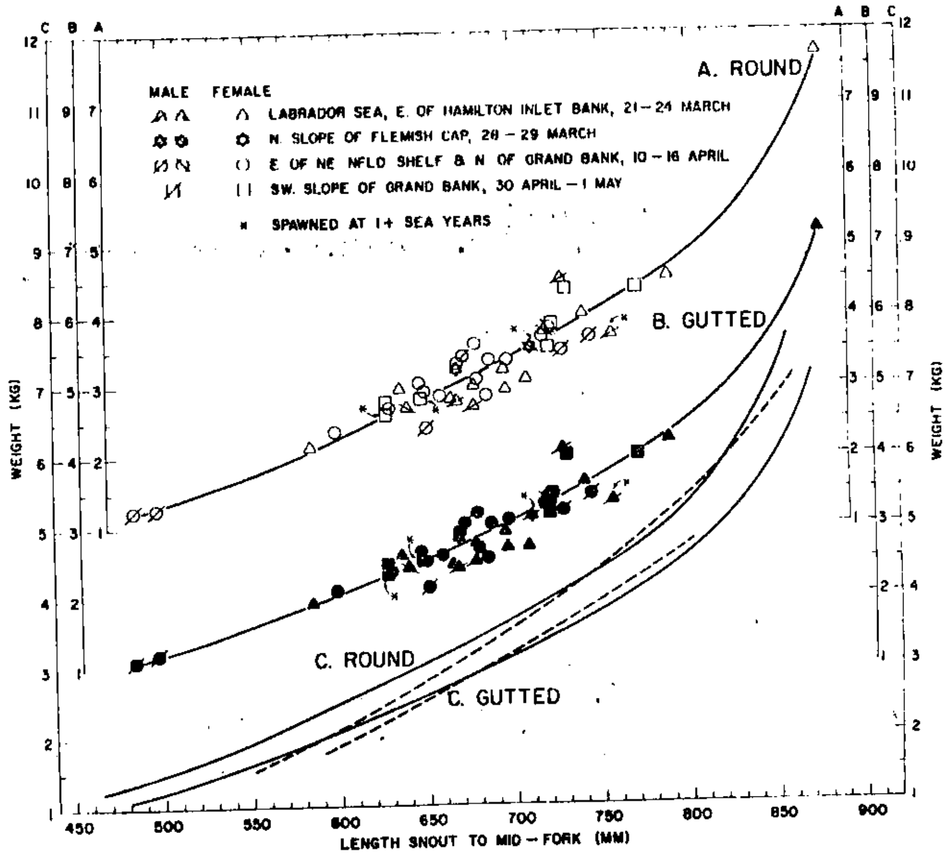

Fig. 4. Length-weight relationships of Atlantic salmon from east and southeast of Newfoundland, 21 March-1 May 1966. (The dashed lines show the round and gutted weights of the Labrador Sea-West Greenland salmon, July-August 1965, Templeman, 1967).

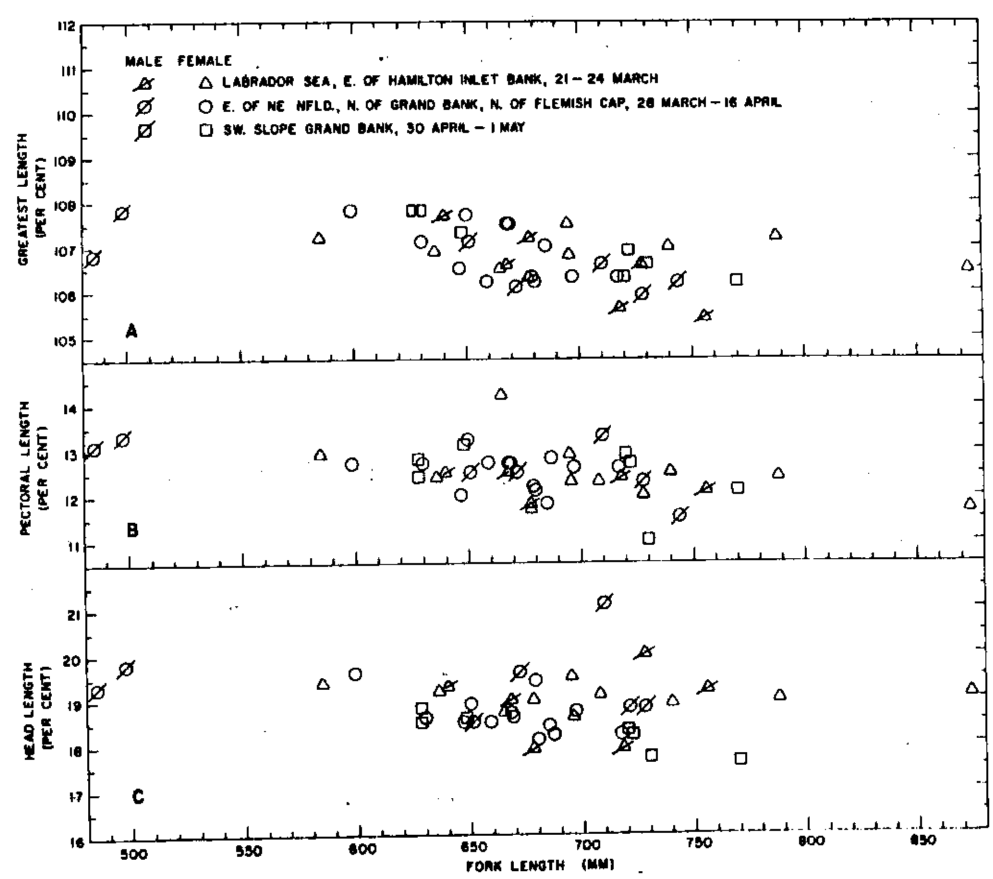

Fig. 5. Head, pectoral fin and greatest lengths relative to the total length to the end of the mid-fork of the caudal fin for Atlantic salmon taken east and southeast of Newfoundland, 21 March-1 May 1966.

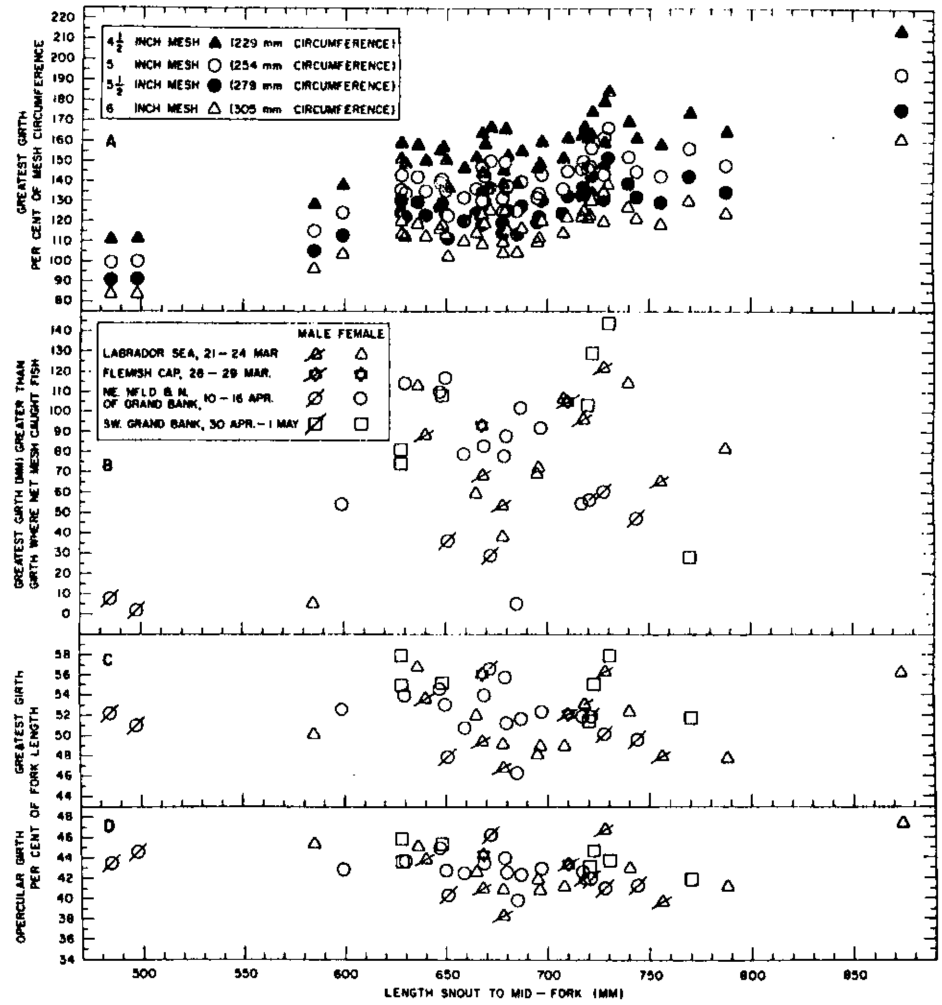

Fig. 6. Length-girth relationships for Atlantic salmon taken east and southeast of Nrwfoundland, 21 March-1 May 1966.

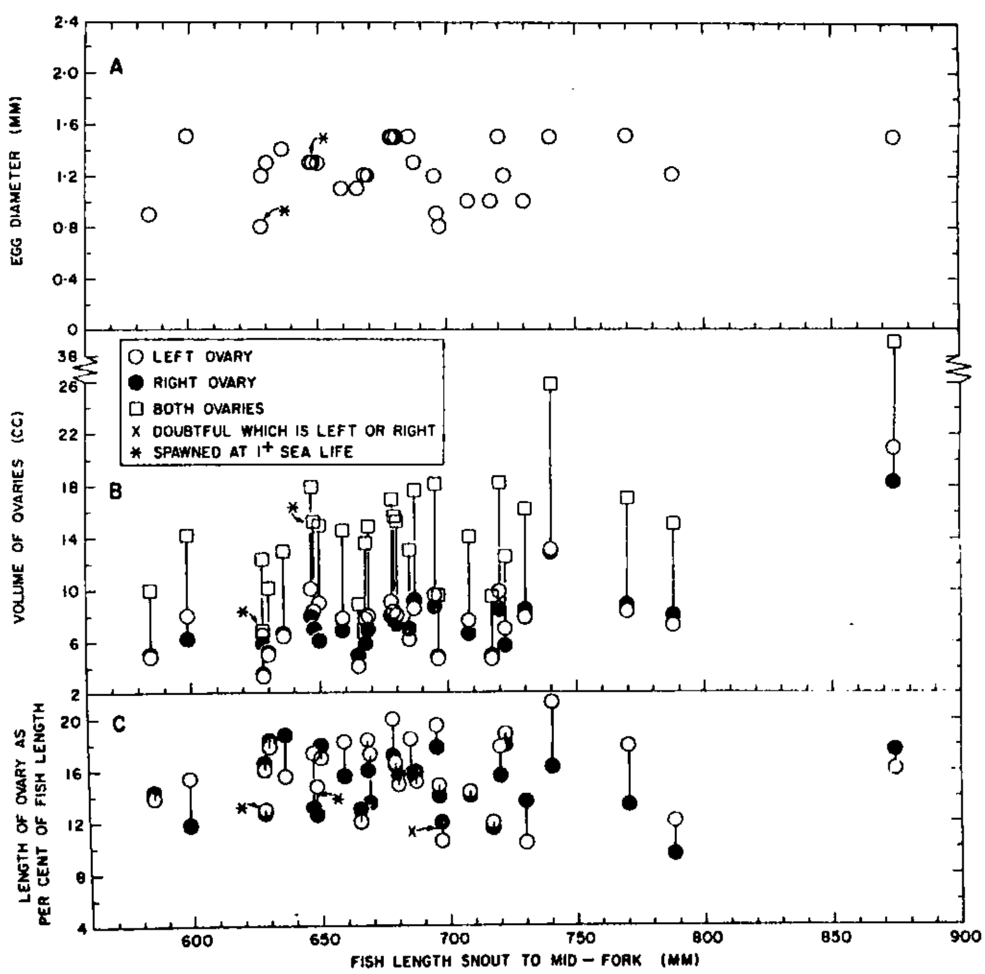

Fig. 7. Egg diameters, and lengths and volumes of ovaries of Atlantic salmon of various fork lengths taken east and southeast of Newfoundland, 21 March-1 May 1966.

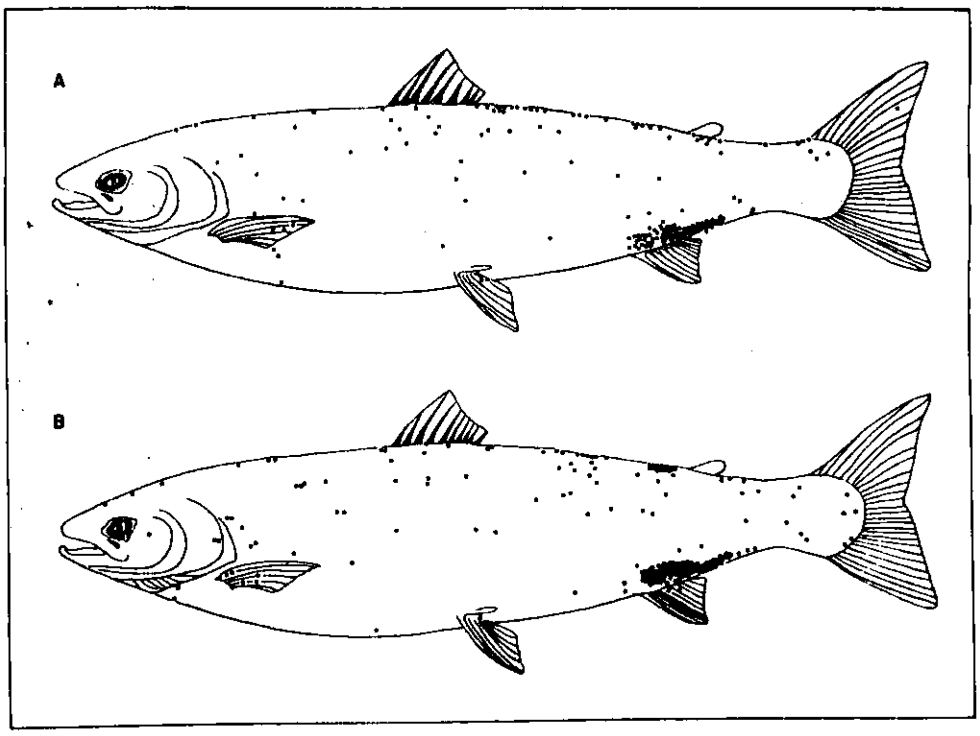

Fig. 8. Distribution of the copepod, Lepeophtheirus salmonis on Atlantic salmon caught by the A.T. Cameron: A, July-August 1965, Labrador Sea-West Greenland and B, March-May 1966, Labrador Sea-Southwest Grand Bank.

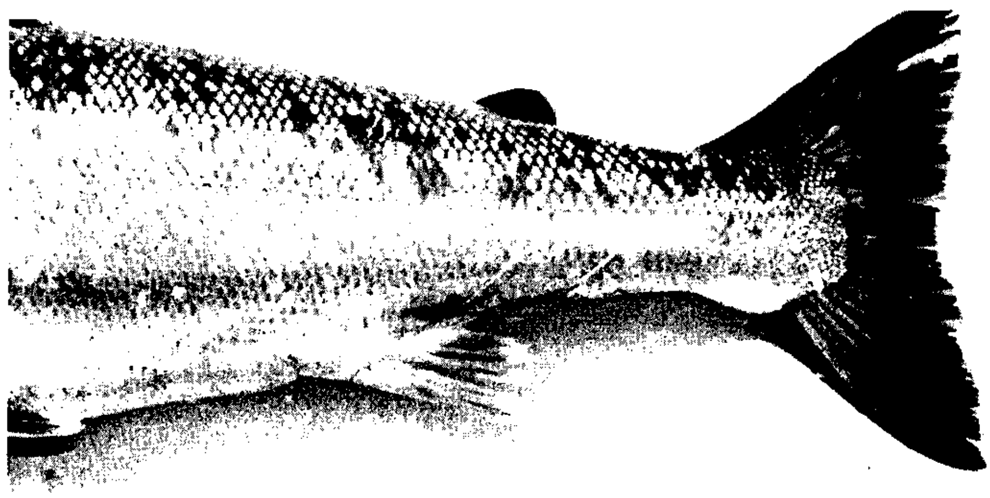

Fig. 9. Four Lepeophtheirus salmonis, 2 with egg-sacs, situated near the posterior end of the anal fin of a female Atlantic salmon, 861 mm fork length, taken by the A.T. Cameron at the mid-mouth of the Labrador Sea, 19-20 July 1965.