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Atlantic Salmon (*Salmo salar*) On and East of the Grand Bank

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Abstract

Exploratory fishing with surface gillnets on the Grand Bank and eastward of the Bank over oceanic depths in May of 1979 and 1980 revealed the presence of Atlantic salmon (*Salmo salar* L.) at most stations where surface temperatures ranged from 3.8° to 7.5° C. These temperatures were more prevalent in the oceanic area and salmon were found in greater abundance there than on the Grand Bank. Of 341 salmon which were caught, 169 were tagged and released after scales were taken for ageing. Information on tagging locations of three salmon which were caught with tags attached and the distribution of recaptures of 12 salmon from the offshore tagging indicated that the offshore population consisted of migrants from Newfoundland, Nova Scotia, New Brunswick and Maine rivers. The sea-age composition of the catch and the gonad condition of the sampled catch indicated that some of the salmon were maturing to spawn as grilse which had spent only one winter at sea. Apart from their capture in coastal fisheries, this is the first record of grilse being caught in offshore areas of the Northwest Atlantic. Analysis of sea-surface temperature charts for 1978–83 indicated that favorable conditions (4° to 8° C water) persist for salmon in January and April, implying that the eastern and southern Grand Bank region may represent not only the route by which maturing salmon migrate from the Labrador Sea to their home rivers in eastern Canada and northeastern United States but also a major feeding and overwintering area. Comparison of catch rates of salmon from commercial and research fishing off West Greenland and in the Irminger Sea with those of the Grand Bank region implies that the feeding population east of the Grand Bank was quite large in 1980.

Introduction

Records of incidental captures of Atlantic salmon (*Salmo salar*) by commercial trawlers (Lear, 1976) and by research vessels (Templeman, 1968; May, 1973) on the Grand Bank during February to June led to the hypothesis that the waters along southwestern edges of the Grand Bank and St. Pierre Bank may represent an overwintering or staging area for salmon during their migration from the Labrador Sea to Canadian east coast rivers (Lear, 1976). Conditions are favourable for salmon in parts of the Grand Bank area, because the merging of the Labrador Current and the Gulf Stream creates eddies and upwellings of nutrient-rich water and an abundance of fish species (Templeman, 1968). According to May (1973), optimal surface temperatures for salmon seem to be in the range of 3° to 8° C.

Specific information on the relative abundance and stock origins of salmon in the Grand Bank region is lacking. However, the existence of a winter-spring migration route across the Grand Bank does have important implications for salmon management strategies. The commercial salmon fishery of Newfoundland and Labrador harvests salmon which originate in rivers of eastern United States (Meister, MS 1984), Nova Scotia and New Brunswick (Saunders, 1969), Quebec (Murray, MS 1966), and Newfoundland and Labrador (Murray, MS 1966, 1968). Salmon which migrate southward from the Labrador Sea towards the Grand Bank and thence westward across St. Pierre Bank could avoid exploitation along the east coast of Newfoundland, and, depending on the timing of their migration, they could partially avoid the fishery along the south coast. In addition to the management implications, offshore oil development on the Grand Bank and its potential impact on the fishery resources necessitate extensive investigation of the fish stocks which inhabit the region. In this paper, aspects of distribution, origin, abundance and biology of Atlantic salmon in surface waters over the Grand Bank and to the east of the Grand Bank are presented on the basis of surveys which were conducted during the spring in 1979 and 1980.

Materials and Methods

Fishing techniques

Gillnet fishing was carried out aboard the motor vessel *Zagreb* mainly over the southern part of the Grand Bank during 1–19 May 1979 and over oceanic depths east of the Grand Bank during 9–30 May 1980 (Fig. 1). In 1979, 15 sets were made at the surface with up to 3,700 m per set of monofilament gillnets (each 45.6 m long) in a string of basic units of three nets with mesh sizes of 127, 140 and 152 mm (length of mesh opening). Each basic unit was 137 m long, and an array of up to 27 units was fished at a time. In 1980, 17 sets were made at the surface with up to 3,850 m per set of monofilament gillnets (each 45.7 m long) in a string of basic units of four nets with mesh sizes of 114, 127, 140 and 152 mm. Each basic unit was 183 m long, and an array of up to 21 units was fished at a time. The nets were 3 m deep.

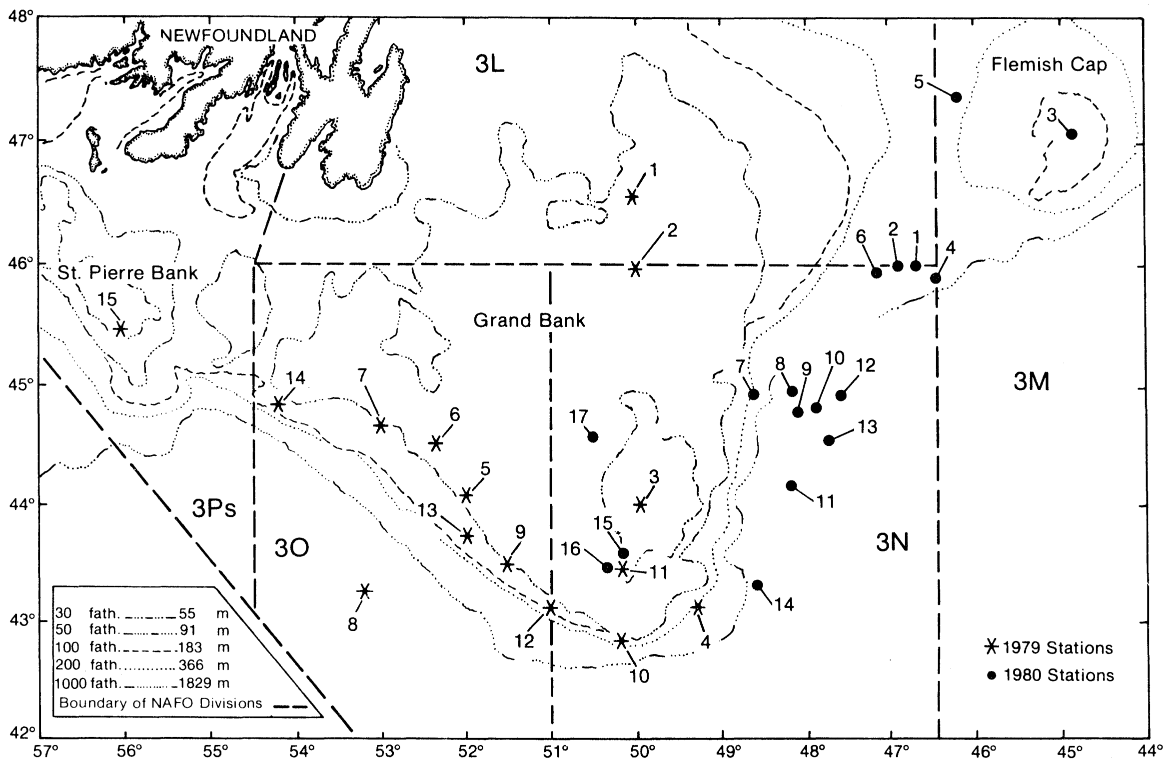

Fig. 1. Locations of sets during surface gillnet fishing for salmon on and east of the Grand Bank in May 1979 and 1980.

Data collection

Live salmon in good condition were marked with modified Carlin tags, according to the technique of Reddin (1984). All salmon, including those not suitable for tagging, were measured as fork length (nearest cm), and scales for age determination were taken from the body position that was recommended by Lear and Sandeman (1980). All salmon which were unsuitable for tagging were weighed (nearest 0.1 kg), the apparent maturity condition was recorded, blood samples were taken for analysis of maturity condition, and the vicera were removed and frozen for subsequent analysis in the laboratory.

Immature and mature male salmon were distinguished visually by the developing condition of the gonads, with milt beginning to accumulate in the latter. The state of maturity of females was determined by radio-immunoassay of blood samples for vitellogenin (Idler *et al*., 1981), whereby maturing fish were separated from immatures on the basis of vitellogenin levels greater than 250 μg/ml. Impressions of five scales from each fish were made on preheated plastic slides and projected onto the ground-glass screen of a microprojector at a magnification of 30x. The ages of these fish were interpreted by standard criteria (Havey, 1959; Berg and Grimaldi, 1967). The stomachs were thawed in water and their contents, if any, were sorted into identifiable components and weighed to the nearest 0.1 g. The condition factor (CF) for individual fish was calculated by the equation used by Lear (1980):

$$CF = (W/L^3) \times 10^5$$

where W is whole weight of fish (kg) and L is fork length (cm).

Analysis of catch-effort data

For comparison with available data from research and commercial fishing for salmon in the Irminger Sea and off West Greenland (Jensen and Lear, 1980), the catch-per-unit-effort (CPUE) data from the 1979 and 1980 surveys in the Grand Bank region were expressed as catches (numbers) per 100 nets, and these values were multiplied by 0.72 to convert them to equivalents for the 33 m nets that were used in the earlier studies. For other comparisons in this study, the CPUE index was expressed as catch (number) per mile-hour, i.e. catch per mile of nets multiplied by the number of hours during which the nets were fished. This index is considered to be a more accurate estimator of abundance than catch per 100 nets.

Oceanographic data

Sea-surface temperatures were recorded for all fishing stations during the 1979 and 1980 surveys. Also, interannual variability in oceanographic conditions off Newfoundland during winter (January) and spring (April) were examined from British Meteorological Charts which are issued monthly from Bracknell, England. These charts, with even-numbered sea-surface temperature isotherms, were constructed from mean temperatures plotted by 1° quadrangles. The actual temperature data were from weather reports by "ships of opportunity". May (1973) noted that salmon were most abundant where sea-surface temperatures ranged from 3° to 8° C. In the absence of 3° isotherms on the British charts, the 4° and 8° isotherms were selected to show the locations of suitable oceanographic conditions for salmon off Newfoundland in winter and spring of 1978 to 1983.

Results

Catch-per-unit-effort

In May 1979, all fishing sets were made over the shelf and slope of the Grand Bank west of 49° W (Fig. 1), and only 14 salmon were caught in 5 of 15 sets, with the catch rates being very low (0.1–0.2 per mile-hour) (Table 1). In May 1980, most of the sets were made eastward of 49° W mainly over oceanic depths off the eastern edge of Grand Bank, and a total of 327 salmon were caught in 16 of 17 sets, with a broad range of catch rates (0.1–3.2 per mile-hour). The three sets on the southern Grand Bank in 1980 (sets 15–17) yielded a total of 35 salmon, the mean catch rate being about 0.4 salmon per mile-hour.

Salmon abundance and sea-surface temperature regimes in 1979 and 1980 cannot be compared, because there was little overlap in the surveyed areas. The results of the 1979 survey, mainly on the Grand Bank, gave little indication of preferred surface temperatures for salmon, because the catch rates were zero in 10 sets where the temperature varied from 1.3° to 7.8° C and were very low in the remaining five sets where the temperature ranged from 2.3° to 6.4° C (Fig. 2). In 1980, on the other hand, most of the sets were made in the oceanic area east of the Grand Bank, where surface temperatures varied from 4.9° to 7.5° C, and one or more salmon were caught in all sets except one. Catch rates were highest (>1.0 salmon per mile-hour) at five stations where the temperature ranged from 5.3° to 7.5° C.

Regional variation in abundance

The expression of catch rate as number of salmon caught per 100 standard nets enabled comparison of the results from the research surveys of the Grand Bank and vicinity with published data from research

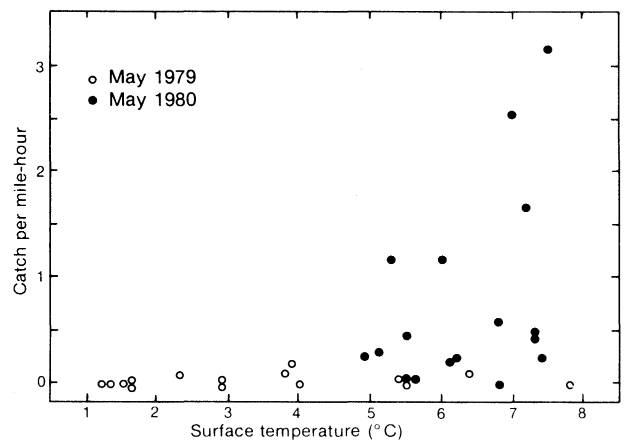

Fig. 2. Catch rates of salmon relative to sea-surface temperatures during the surveys on and east of the Grand Bank in May 1979 and 1980.

TABLE 1. Numbers of salmon caught and tagged, catch rates (number per mile-hour) and surface temperatures from exploratory fishing with surface gillnets on and east of the Grand Bank in May of 1979 and 1980. (See Fig. 1 for locations of sets.)

1979					1980				
Set no.	Date	No. caught (tagged)	Catch rate	Temp. (° C)	Set no.	Date	No. caught (tagged)	Catch rate	Temp. (° C)
1	May 01	0	—	1.6	1	May 09	34 (17)	1.16	6.0
2	May 02	0	—	1.3	2	May 10	5 (2)	0.25	6.2
3	May 03	1	0.11	2.3	3	May 11	1	0.05	5.6
4	May 04	0	—	1.2	4	May 12	11 (5)	0.58	6.8
5	May 05	0	—	2.9	5	May 13	1 (1)	0.05	5.5
6	May 09	0	—	1.5	6	May 14	6 (5)	0.20	6.1
7	May 10	0	—	1.6	7	May 15	22 (12)	1.16	5.3
8	May 12	0	—	7.8	8	May 20	90 (42)	3.18	7.5
9	May 13	0	—	2.9	9	May 22	72 (41)	2.56	7.0
10	May 14	1	0.09	3.8	10	May 24	29 (13)	1.66	7.2
11	May 15	7 (2)	0.20	3.9	11	May 25	6 (1)	0.46	7.3
12	May 16	3 (2)	0.09	6.4	12	May 26	10 (6)	0.50	7.3
13	May 17	2	0.07	5.5	13	May 27	5 (2)	0.25	7.4
14	May 18	0	—	4.0	14	May 28	0	—	6.8
15	May 19	0	—	5.5	15	May 29	10 (6)	0.27	4.9
					16	May 29	19 (10)	0.46	5.5
					17	May 30	6 (2)	0.30	5.1
Total		14 (4)					327 (165)		

TABLE 2. Average catches (numbers per 100 nets) of salmon from research and commercial fishing with surface gillnets in various regions of the North Atlantic, 1972–80. (* indicates commercial fishing.)

		Jensen & Lear (1980)		This study	
Year	Month	West Greenland	Irminger Sea	Grand Bank	E. Grand Bank
1972	Aug-Sep	11.3	—	—	—
	Aug-Oct	42.0*	0.7*	—	—
1973	Aug	41.0*	5.7	—	-
1974	Jul	44.0*	8.5	—	—
	Aug	72.0*	2.1	—	—
1975	Aug	111.0*	11.9	—	—
1979	May	—	—	1.0	—
	Aug-Sep	21.8	—	—	—
1980	May	—	—	10.0	20.8
	Aug-Sep	35.1	—	—	—

and commercial fishing off West Greenland and in the Irminger Sea (Table 2). The mean catch rate for the oceanic area east of Grand Bank (20.8) was substantially higher than values from research fishing in the Irminger Sea during 1973–75 and off West Greenland in 1972, was similar to the West Greenland value for 1979, and somewhat lower than the West Greenland value for 1980. The catch rates from all research fishing throughout the region were considerably lower than those from commercial fishing activity, as would be expected due mainly to differences in fishing strategy. Salmon were much less abundant on the Grand Bank than in the oceanic area east of the Grand Bank in 1980, but it should be noted that the 1979 and 1980 catch rates for the Grand Bank are not directly comparable because of differences in survey coverage.

Tagging results and origin of salmon

A total of 169 salmon were tagged and released during the surveys of the Grand Bank and vicinity (4 in 1979 and 165 in 1980). There have been 12 reported recaptures, all from the 1980 tagging. Five were recaptured in rivers (four by anglers in New Brunswick rivers and one at Morgan Falls fishway, LaHave River, Nova Scotia) and seven in the commercial fishery of Newfoundland and Labrador (Fig. 3). All except one of the recaptures occurred in 1980, the exception being a fish angled in 1981 on the Kouchibouguac River, New Brunswick. This salmon was caught in the spring and was a kelt that must have entered the river to spawn in the previous year. The five salmon that were recaptured in rivers were all 2-sea-winter (2-SW) salmon when tagged. The recaptures in the Newfoundland commercial fishery consisted of five 2-SW and two 1-SW salmon.

During the Grand Bank and vicinity surveys, three salmon were caught with tags attached. These fish had been tagged as smolts, two at Mactaquac Fish Culture Station, Saint John River, New Brunswick, and one at Green Lake National Fish Hatchery in Maine. All were 1-SW salmon when recaptured.

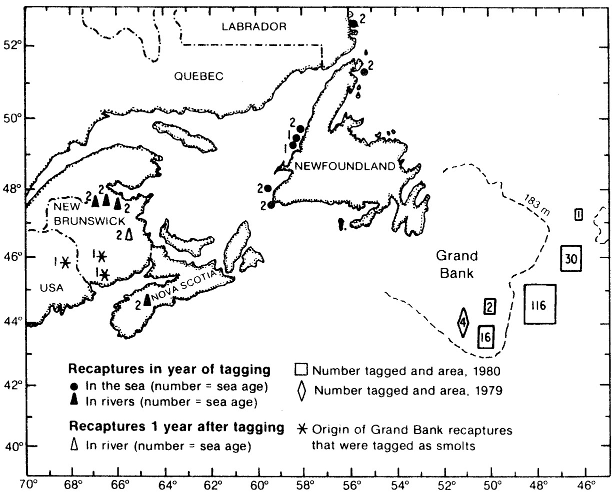

Fig. 3. Numbers of salmon tagged on and east of the Grand Bank in May 1979 and 1980, and subsequent recaptures in the coastal fishery and in rivers. (Numbers associated with recaptures are sea-ages.)

Age composition, sex and maturity

The sea-age composition of all salmon that were caught during the 1979 and 1980 surveys (14 and 327 respectively for a total of 341) was 49.0%, 48.4%, 0.6% and 2.1% for 1-SW, 2-SW, 3-SW and previous spawners respectively. With respect to the smolt ages (river age at smoltification) of these salmon, the composition was 5.9%, 29.7%, 51.4%, 12.7% and 0.3% for 1, 2, 3, 4 and 5 years respectively.

Sea-ages by sex were determined for 170 salmon which were sampled during the 1979 and 1980 surveys (Table 3). There were more males (54%) than females (46%), but the numbers were not significantly different ($P>0.10$) when tested by chi-square with Yates' correction for small samples. However, the sex ratios differed greatly by age-group, there being a significantly higher number of 1-SW males than females ($P<0.01$) and a higher number of 2-SW females than males ($P<0.05$). These two age-groups were represented by 95% of the fish in the sample.

Maturity determinations were available for 85 males from visual examination of testes and for 71 females from Vg levels in blood samples (Table 3). The analysis indicated that 32% of the males were immature and would not have returned to their home rivers to spawn in the year of capture, whereas 68% were maturing to spawn in the year of capture. For females, only 7% were classified as immature, and 93% were considered to be maturing and would have returned to their home rivers to spawn in the year of capture.

Food and feeding

Analyses of stomach contents of salmon from the Grand Bank and the oceanic area east of the Grand Bank revealed major differences in food composition

TABLE 3. Sea-age compositions (numbers) by sex and also by sex and maturity of salmon from the Grand Bank region, 1979–80. (PS = previous spawners; Imm = immature; Mat = maturing.)

Sea age (yr)	No. sampled by sex[a]		No. by sex and maturity[a]			
			Male		Female	
	Male	Female	Imm	Mat	Imm	Mat
1	56	22	24	32	4	18
2	32	52	3	24	0	47
3	0	2	0	0	1	0
PS	4	2	0	2	0	1
Total	92	78	27	58	5	66
(%)	(54)	(46)	(32)	(68)	(7)	(93)

[a] Totals differ because maturity condition was not determined for all fish that were sexed.

(Table 4). Sand lance (*Ammodytes* sp.) and capelin (*Mallotus villosus*) constituted 93% of the food in stomachs from the Grand Bank, with infrequent incidence of shrimp larvae, barracudina (*Paralepis coregonoides borealis*) and unidentified fish remains, and 13% of the 23 stomachs were empty. In the oceanic area, the stomach contents consisted of 68% fish and 32% invertebrates, with 22% of the 146 stomachs being empty. The invertebrate prey were almost entirely amphipods, and the fish prey were mainly barracudina, black smelt (Bathylagidae) and unidentified remains.

The mean weight of food per stomach was about five times higher in salmon from the Grand Bank than in those from the oceanic area (Table 4), and the mean weights of food per kg of salmon for the two areas differed by approximately the same factor. However, the mean condition factors for salmon from the Grand Bank and the oceanic areas were essentially the same (1.07 and 1.08 respectively). For the oceanic area, where the sample of stomachs was reasonably large, there was no difference in feeding intensity of immature and maturing salmon, the mean weights of food per kg of salmon being 4.2 and 4.1 g respectively. It is interesting that the feeding intensity of salmon was higher in the Grand Bank area whereas the salmon were more abundant in the oceanic area.

Interannual variability in oceanographic conditions

Sea-surface temperatures of 4° to 8° C occur consistently during winter and spring in bands of variable width off eastern Newfoundland and along the eastern slope of the Grand Bank (Fig. 4). In April of 1979, 1980, 1981 and 1982, the 4° to 8° C surface water was located in the oceanic area east of the Grand Bank, whereas in 1978 and 1983, it extended westward over the eastern and southern slopes of the Bank. In each of the 6 years during the winter and spring, the band of 4° to 8° C surface water turns westward near the southern tip of the Grand Bank and continues along the southwestern slope.

TABLE 4. Stomach contents of Atlantic salmon from the Grand Bank (GB) and east of the Grand Bank (EGB) in May of 1979 and 1980 combined. (+ indicates insignificant quantity.)

Food components	Number of occurrences		Percent by weight	
	GB	EGB	GB	EGB
Polychaetes	—	1	—	+
Nematodes	—	4	—	+
Amphipods	2	58	0.1	31.9
Decapods (shrimp larvae)	1	8	2.6	0.1
Capelin (*Mallotus villosus*)	7	—	26.3	—
Sand lance (*Ammodytes* sp.)	18	—	66.7	—
Barracudina (*Paralepis* sp.)	2	14	2.4	24.7
Black smelt (Bathylagidae)	—	32	—	23.9
Lanternfish (Myctophidae)	—	3	—	1.6
Unidentified fish remains	2	49	1.9	17.8
Unidentified material	1	5	+	+
Number of stomachs examined			23	146
Number of empty stomachs			3	32
Total weight of food in stomachs (g)			1,450	1,860
Total weight of salmon examined (kg)			73.3	458.0
Weight of food per stomach examined (g)			63.1	12.7
Weight of food per kg salmon weight (g)			19.8	4.1
Condition factor			1.07	1.08

Discussion

Very little information was known about the migrations and sea-feeding areas of Atlantic salmon until the development of an intensive salmon fishery off West Greenland in the 1960's demonstrated that they occurred there in abundance. Recaptures of salmon, tagged as smolts in rivers on both sides of the North Atlantic and as adults at Greenland, have indicated that the catches off West Greenland consisted mainly of 1-SW fish, which originated mainly in rivers of eastern Canada, Norway, Scotland and Ireland and which would not have spawned until the year after their capture (ICES, 1979; Jensen, 1980a, 1980b). Templeman (1968) and May (1973) reported the spring and autumn occurrence, in the Labrador Sea, of salmon which had spent more than one winter in the sea. The salmon were concentrated about 480 km east of the Strait of Belle Isle in the spring and were found in the Labrador Sea about halfway between southern Labrador and southern Greenland in the autumn. Neither of these studies reported the offshore capture of salmon that would mature as grilse. From the blood Vg level in 1-SW females and testes development in 1-SW males, which were caught during the 1979 and 1980 surveys of the Grand Bank region, it was evident that some of the salmon would have matured to spawn in the year of capture. This is the first reported capture of potential grilse anywhere in the Northwest Atlantic except in the coastal fisheries.

Comparison of catch rates from the surveys off Newfoundland with those from commercial and

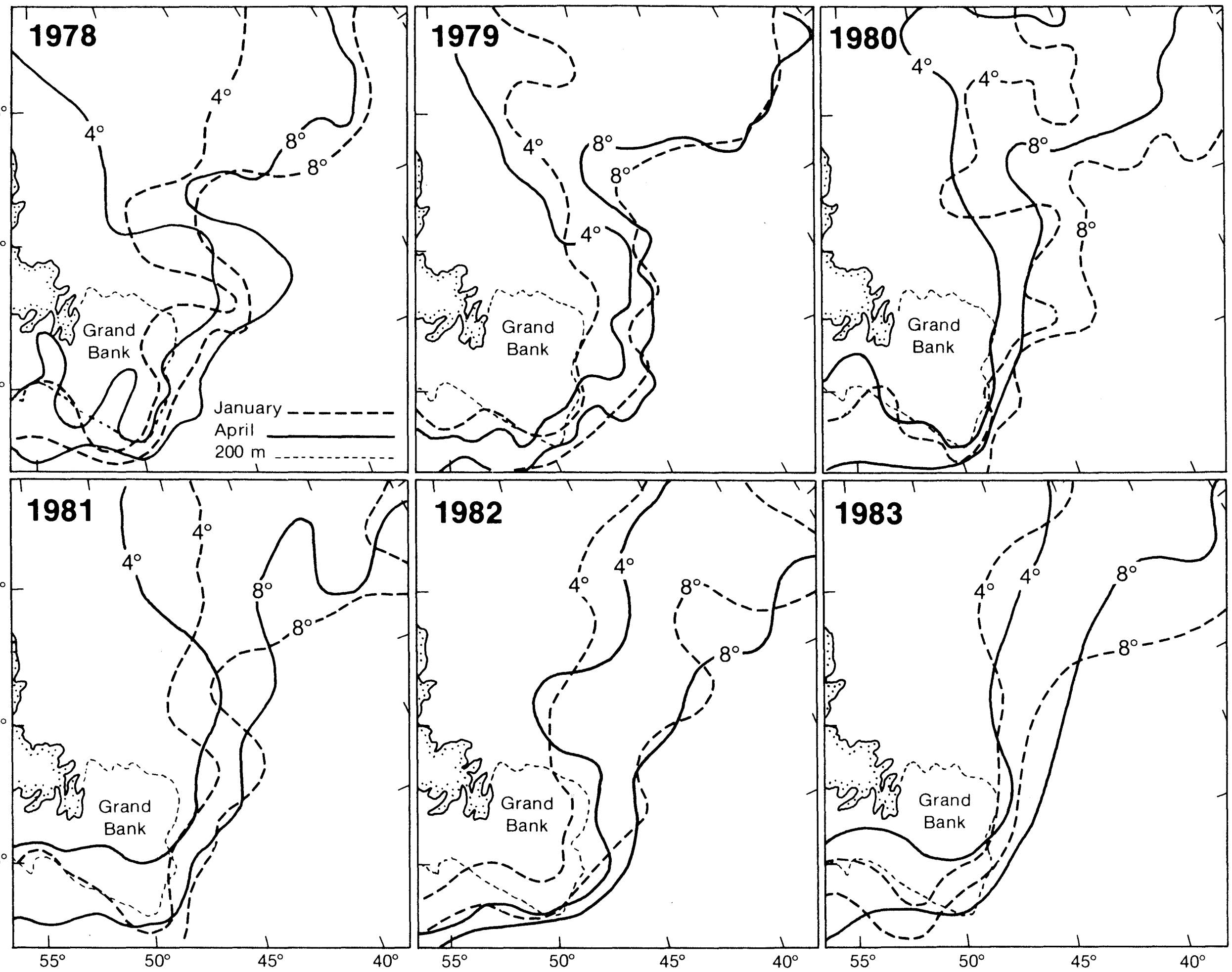

Fig. 4. Surface-temperature conditions in the Grand Bank region as indicated by locations of the 4° and 8° C isotherms in January and April, 1978–83. (Isotherms are from monthly ice charts issued by the British Meteorological Office, Bracknell, England.)

research fishing off West Greenland indicated that significant numbers of salmon inhabit the oceanic areas off Newfoundland. The results from a tagging program at West Greenland in 1972 yielded an exploitation rate of about 0.30 (Andersen *et al.*, 1980), from which the total population was estimated to be about 2 million salmon (Horsted, 1980). It is impossible to derive a realistic estimate of the total population from direct comparison of research catches off Newfoundland and commercial catches off West Greenland. However, comparison of the catch rate from research fishing in the oceanic area southeast of Newfoundland in 1980 (20.8 salmon per 100 standard nets) with those from research fishing off West Greenland in 1972 and 1979–80 (11.3–35.1 salmon per 100 nets) indicates that, in some years, there may be as many (or more) salmon per unit area off Newfoundland as there are off West Greenland.

The movements of three previously-tagged salmon which were caught and the subsequent river recaptures of salmon which were tagged during the 1979–80 surveys indicate that some of the salmon in the offshore fishing area originated in New Brunswick, Nova Scotia and Maine rivers. However, tag recoveries from the commercial salmon fishery along the west and northeast coasts of Newfoundland indicate that some of the fish in the offshore fishing area may have originated in Newfoundland and Labrador rivers. According to Pippy (MS 1982), the fishery on the west coast of Newfoundland harvests primarily salmon of Newfoundland origin. No tag recoveries were reported from Quebec.

Examination of the smolt (river) ages of salmon from the Grand Bank region provided some information on the general location of home rivers. Lear and Misra (1978) demonstrated that mean river age of North American salmon populations increased significantly with latitude. The good representation in the catches of salmon with smolt ages of 1 and 2 years imply that these fish were of southern origin, although the southwest area of Newfoundland has rivers which produce some age 2 smolts (Evans *et al.*, 1985).

Catches of salmon with smolt ages of 3 and 4 years indicate that some of the fish in the area were of Newfoundland-Labrador origin. The mean river age of 2.7 years for salmon in this study corresponds approximately to 46° N lat. (i.e. southern Gulf of St. Lawrence). The mean river age of 3.2 years for salmon which were caught in spring in the Labrador Sea (Templeman, 1968) implies a more northerly origin for these fish than for the salmon from the Grand Bank area.

Lear (1976) hypothesized from trawler catches of salmon off Newfoundland that "the shelf area of the Grand Bank may be an area where salmon overwinter before returning to their rivers of origin in the spring". He further suggested that "the Grand Bank and southwestern St. Pierre Bank slopes may form a winter-spring staging area for salmon *en route* from the Labrador Sea". Salmon of all sea-age classes were found to inhabit the oceanic area east of the Grand Bank in the spring of 1980, and the catch rate there was much higher than those on the Grand Bank in 1979 and 1980. This implies that the oceanic area rather than the Grand Bank was the main staging area for salmon in 1980. However, the winter and spring sea-surface temperature data for 1978-83 indicate that oceanographic conditions for salmon may be more favorable on the Grand Bank in some years and east of the Grand Bank in others.

Prior to 1984, the season for commercial salmon fishing along the east and south coasts of Newfoundland began between 15 and 20 May. Distribution of catches indicated that salmon were present along the south coast about 2 weeks earlier than along the northeast coast and that larger salmon approached the coast earlier than grilse (Short and Reddin, MS 1981). The area southeast of Newfoundland may be a staging area for salmon which move southward from the Labrador Sea in early spring. However, because suitable temperature conditions (4° to 8°C) exist during the winter south and east of the Grand Bank, where cold water of the Labrador Current merges with warm water of the Gulf Stream, some of the salmon from Canadian and United States rivers may overwinter there. In the spring, they probably migrate to Newfoundland coastal waters and westward into the Gulf of St. Lawrence. This would explain the early appearance of salmon along the south coast of Newfoundland.

From analysis of stomach contents, the major prey of salmon on the Grand Bank were capelin and sand lance. In the oceanic area east of the Grand Bank, the main food components were fish (i.e. barracudina and black smelt) and amphipods. Some factor other than food must influence the distribution of salmon in the sea, because the salmon from the Grand Bank had five times the weight of food per stomach than those from the oceanic area but catch rates were much higher in the oceanic area. May (1973) suggested that salmon are found in abundance where surface temperatures are 3° to 8° C and food organisms are abundant. During the 1979 and 1980 surveys, salmon were found at most stations where surface temperatures were 3° to 8° C but were most abundant where temperatures were 5° to 8° C. Such temperatures were more prevalent in the oceanic area east of the Grand Bank than on the Grand Bank itself. The food supply was presumably adequate in the oceanic area even though the average amount of food in the stomachs was much less than the amount of food in the stomachs of salmon from the Grand Bank.

According to Lear (1980), salmon in the Labrador Sea had less food in their stomachs in the autumn than in the spring (3.1 g and 5.7 g food per kg of salmon respectively) and were feeding less actively (28% and 8% empty stomachs respectively).In the same report, the stomach contents of salmon off West Greenland ranged from 4.8 g to 11.4 g food per kg of salmon, and about 11% of the stomachs were empty. The amount of food in the stomachs of salmon on the Grand Bank (19.8 g food per kg of salmon) exceeded values for salmon at West Greenland and in the Labrador Sea but was less than the average (31.1 g) for salmon in Newfoundland-Labrador coastal waters (Lear, 1972). Stomachs of salmon in the oceanic area east of the Grand Bank contained less food than those from West Greenland and Labrador Sea in the spring but more than those from the Labrador Sea in the autumn.

The wide variety of prey species in salmon stomachs indicates that adult salmon are opportunistic feeders and prey on whatever organisms are available in the area. During their homeward migration along the Newfoundland coast, adult salmon are known to feed mainly on capelin and sand lance, with small amounts of shrimp, smelt, cod, herring and brook trout (Lindsay and Thompson, 1932; Lear, 1972). However, feeding almost ceases just before the salmon enter their home rivers to spawn (Kendall, 1935; Jones, 1959; Keenleyside, 1962; Power, 1969). In the major feeding areas off West Greenland, salmon prey mainly on capelin and sand lance, whereas, in the Labrador Sea, salmon prey on paralepids, lanternfish, arctic squid (*Gonatus* sp.), and amphipods (Lear, 1980). Thus, capelin is not considered to be the principal component of the salmon diet throughout its life history as some authors have speculated (Carter, 1979, 1980).

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