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Ichthyoplankton from the Flemish Cap Bank

by

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#### Introduction

Dannevig (1919) reported on the results of the first ichthyoplankton survey off Newfoundland which formed part of the Canadian Fisheries Expedition of 1914-15. Since then, many scientists have reported data on the occurrence of fish eggs and larvae in the Northwest Atlantic, but no data have been reported for the Flemish Cap area. Regular ichthyoplankton surveys in the Northwest Atlantic, initiated in the late 1950's by the Polar Research Institute of Marine Fisheries and Oceanography (PINRO), have provided material on the species composition of the ichthyoplankton and on the distribution of fish eggs and larvae of some commercial fishes. This paper presents the results of studies on the distribution of the eggs and larvae of cod, the larvae of redfish and the eggs of American plaice in the Flemish Cap area.

#### Materials

The material for this study was collected in March-April of 1959-63, 1966 and 1970 on the Flemish Cap (Fig. 1). About 500 samples were taken with a cone-shaped gauze net of 80 cm in diameter and a mesh size of 0.71 mm. Nearly all of the samples were taken in vertical tows through the water column from bottom to surface on the bank and from 300 m to surface on the slopes. The samples were preserved in 2 or 4% formalin.

Eggs, larvae and fry of 23 fish species were recorded from the area, with cod eggs and larvae, redfish larvae and American plaice eggs occurring in the greatest abundance (Table 1).

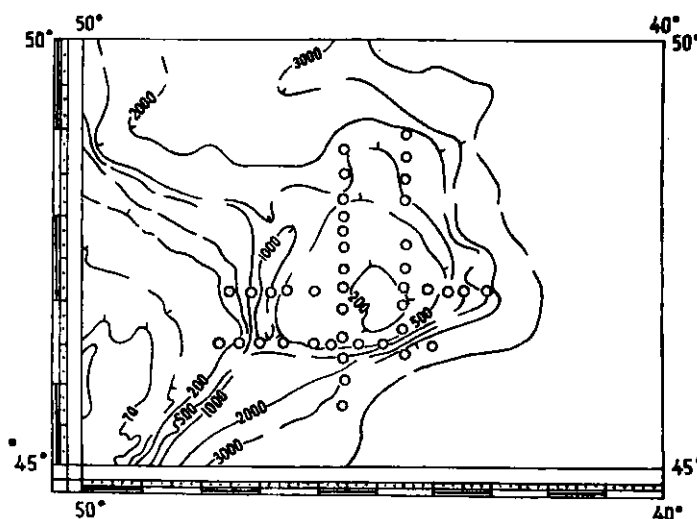


Fig. 1. Ichthyoplankton stations in the Flemish Cap area. (Depth contours in meters.)

Table 1. Species composition of ichthyoplankton on Flemish Cap Bank.

Common name	Scientific name	Number of specimens		
		Eggs	Larvae	Fry
Atlantic cod	<i>Gadus morhua</i> L.	2383	56	-
North Atlantic redfish	<i>Sebastes</i> sp.	-	960	-
American plaice	<i>Hippoglossoides platessoides</i> Fabr.	372	-	-
Yellowtail flounder	<i>Limanda ferruginea</i> (Storer)	28	-	-
Capelin	<i>Mallotus villosus</i> (Müller)	-	-	21
Anglemouth	<i>Cyclothone signata</i> Garmen	-	19	-
Cusk	<i>Brosme brosme</i> (Müller)	11	9	-
American sand lance	<i>Ammodytes americanus</i> DeKay	-	15	-
Witch flounder	<i>Glyptocephalus cynoglossus</i> (L.)	13	-	-
Haddock	<i>Melanogrammus aeglefinus</i> (L.)	11	-	-
White barracudina	<i>Paralepis rissoi krøyeri</i> Lutken	-	5	-
Pollock	<i>Pollachius virens</i> (L.)	-	5	-
Fourbeard rockling	<i>Encheliopus cimbrius</i> (L.)	3	-	-
Alligatorfish	<i>Aspidophoroides monopterygius</i> (Bloch)	-	-	3
Atlantic argentine	<i>Argentina silus</i> (Ascanius)	-	1	-
Lanternfish	<i>Notoscopelus elongatus</i> (Costa)	-	-	1
European ling	<i>Molva molva</i> (L.)	-	1	-
Grenadiers	<i>Macrourus</i> sp.	-	-	1
Skipjack tuna	<i>Katsuwonus pelamis</i> (L.)	-	1	-
Bluefin tuna	<i>Thunnus thynnus</i> (L.)	-	1	-
Sculpins	<i>Myoxocephalus</i> sp.	-	1	-
Sea snail	<i>Neoliparis atlanticus</i>	-	1	-

## Results

### Cod

In March, cod eggs occurred above depths of 300-500 m on the western part and over oceanic depths on the eastern part of Flemish Cap (Fig. 2). In early April, they were observed along the northeastern, southern and southwestern slopes of the Bank above depths of 290-450 m. In the area southwest and east of the Bank, several eggs at early stages of development were found above depths greater than 2000 m. Individual eggs were recorded from the central part of the Bank above a depth of less than 100 m. In May, eggs occurred along the southwestern slope and in the shallow portion of the Bank. The numbers of eggs taken during all periods was not high, less than 10 per vertical haul. Cod eggs, in early stages of development, were recorded mainly in March and April. Cod larvae 4.0-4.5 mm long were observed above depths of 150-255 m on the central part of the Bank in April and along the southwestern slope in July and August.

The distribution of eggs in the March-August period is indicative of the prolonged spawning of cod on the Bank (Fig. 2). The peak of spawning occurs in March and early April as shown by the distribution of eggs at early developmental stages and the predominance of spawning cod in the commercial catches (Serebryakov, 1967). Spawning occurs mainly along the southwestern slope of the Bank at depths of 300-500 m. The drift of eggs and larvae seems to follow a pattern. Eggs spawned along the southwestern slope are carried to the central part of the Bank in a cyclonic current which governs water circulation in this area. Anticyclonic water circulation over the northeastern part of the Bank contributes to the drift of eggs and larvae from the spawning grounds on the northeastern slope to the central part of the Bank. The current velocity is not high, about 0.1 knot (Buzdalin and Elizarov, 1962). Eggs spawned on the slopes reach the central part of the Bank 23-30 days later. By that time they have reached the early larval stage (at water temperature of about 5°C) and are 5.5 mm or more in length. Larvae one summer old are found in the central part of the Bank. This indicates that they prefer the off-bottom way of life in this area.

### Redfish

Larvae of *Sebastes marinus* and *S. mentella* occur over the Flemish Cap Bank. The larvae have not yet been identified as to species. However, larvae recorded in

the samples can be tentatively referred to as *S. mentella* (or *S. fasciatus*) since in the investigated area the spawning females of this species were far more abundant than those of *S. marinus*. In March, larvae were recorded mainly along the north-western slope of the Bank (Fig. 3), sometimes up to 200 specimens per vertical haul. On the Bank itself, only individuals in the early larvae stage occurred. In April, redfish larvae in early stages of development were very abundant along the western and eastern slopes of the Bank. The greatest abundance of larvae from 7.00 to 10.0 mm in length was recorded in May. Early larvae of 10.0 to 13.0 mm and larvae of 14 mm and more in length occurred sometimes along the southern and western slopes of the Bank above depths of 165-1140 m. Large-size larvae were recorded above lesser depths. Larvae from 9.0 mm in length were found in the central part of the Bank above a depth of 165 m, while larvae less than 8 mm in length occurred only above depths of more than 400 m. In June, July and August, larvae of 10 to 15 mm in length were observed mainly in the central part of the Bank.

The peak period of extrusion of redfish larvae is in April and May, as evidenced by the abundance of larvae, and also occurrence of spawning females in the commercial catches. More than 55% of the females were spawning in April and 60% in May. During other months the numbers of spawning females was not more than 15%. The extrusion of larvae takes place at a depth of more than 400 m (Chekhova, 1972). Larvae extruded on the southern and western slopes are carried by the currents to the central part of the bank (the largest larvae were taken there), where they seem to prefer an off-bottom way of life. Larvae from the northern and northeastern slopes are also carried to the central part of the Bank, but, in this case, some may be carried off the Bank.

#### American plaice

A significant number of American plaice eggs was recorded in Flemish Cap beginning in the latter half of March. The greatest number of eggs (up to 100 per vertical haul) was found in the central part of the Bank above depths of 150-320 m during the latter half of May (Nevinsky and Serebryakov, 1973). Spawning females were recorded on the Flemish Cap Bank from March through September. Judging from the catches of eggs, spawning takes place on the central part of the Bank mainly at depths of 150-200 m from mid-May to July.

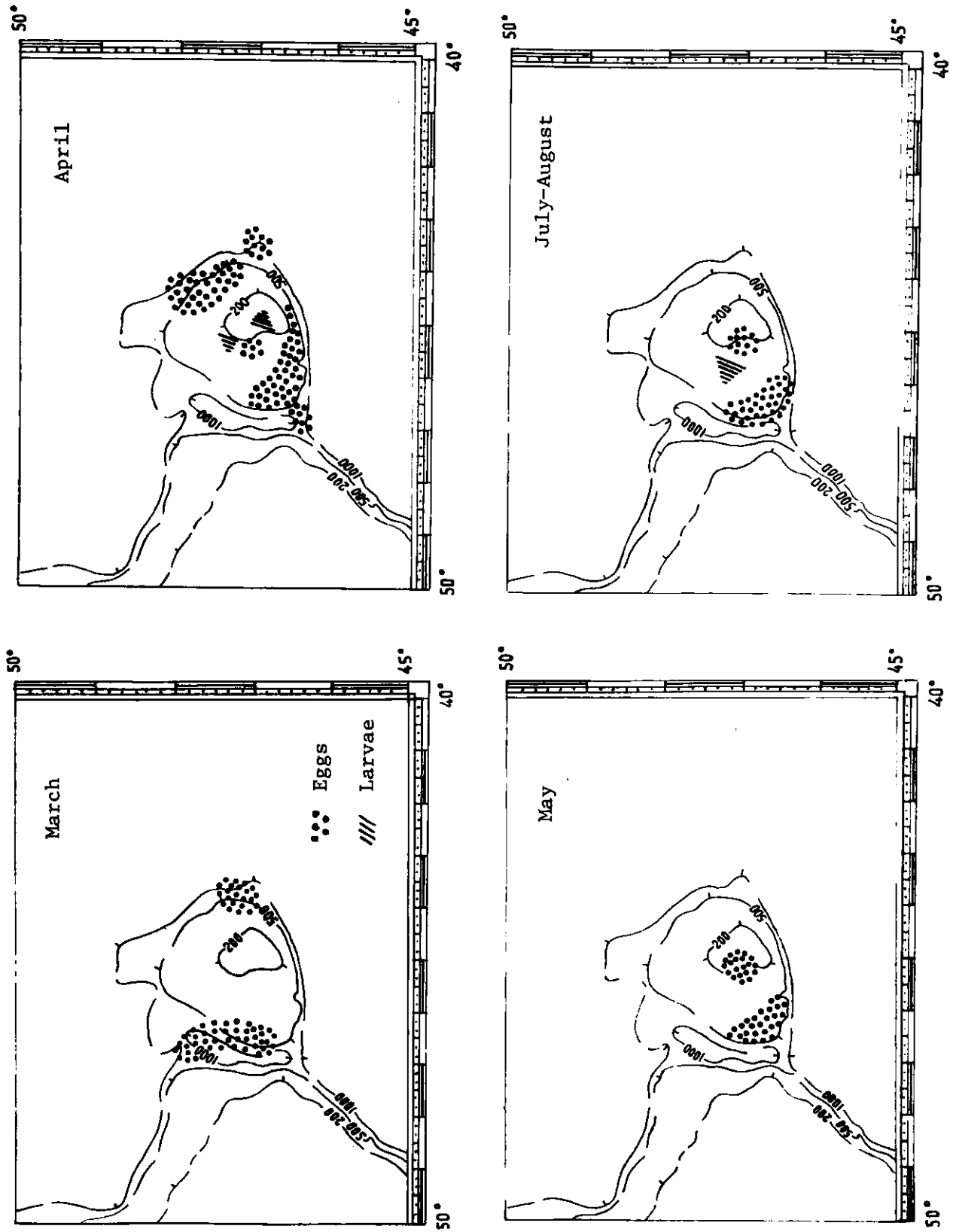


Fig. 2. Distribution of cod eggs and larvae in the Flemish Cap area. (Depth contours in meters.)

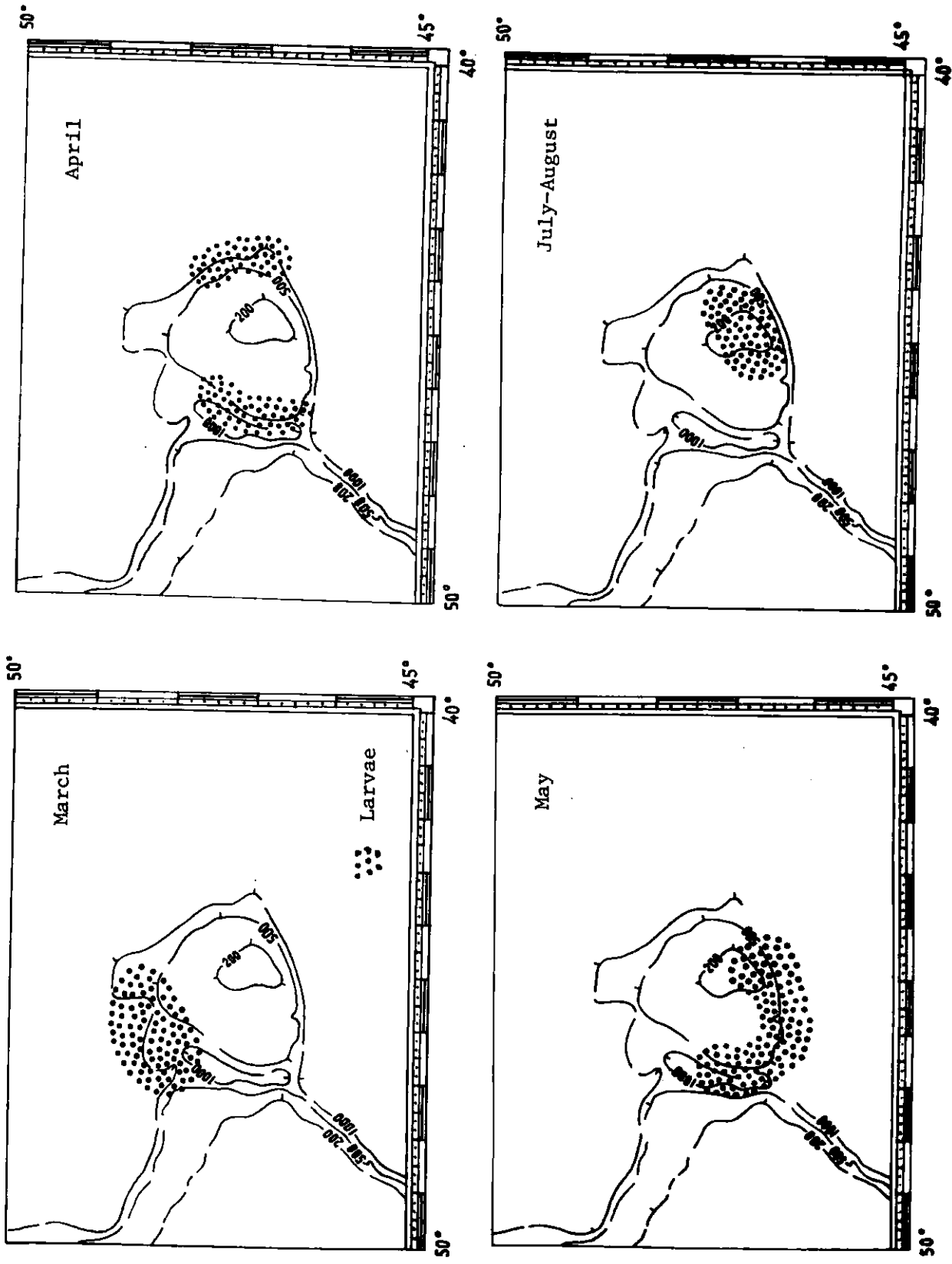


Fig. 3. Distribution of redfish larvae in the Flemish Cap area. (Depth contours in meters.)

Discussion

The hydrological climate of Flemish Cap Bank is less severe than that of the adjacent fishing areas of Labrador and the Grand Bank of Newfoundland. In its northern and northeastern areas, Flemish Cap Bank is washed by a branch of the Labrador Current called the Flemish Cap Current which consists of the peripheral waters of Atlantic origin with a current velocity of 0.2-0.3 knots. Over the northern slope an insignificant part of the current turns to the northwest, while the main mass flows along the eastern edge to the southern slope of the Bank and then is brought to the northeast by the North Atlantic current. The southern part of the Bank is washed by a current of about 0.5 knots which consists of mixed water of Gulf Stream origin. The above-mentioned currents constitute a specific water circulation of about 0.1 knot over Flemish Cap Bank, with a cyclonic current recorded in the southwestern and an anticyclonic current in the northeastern part of the Bank.

These currents provide a closed cycle of passive migrations in the Flemish Cap area (Fig. 4). The spawning of cod and redfish takes place in deep waters along the slopes of the Bank. Eggs and larvae are then brought to the relatively shallow central part of the Bank. The low current velocity determines the duration of drift of eggs and larvae when the preparation for an active pelagic or off-bottom way of life takes place.

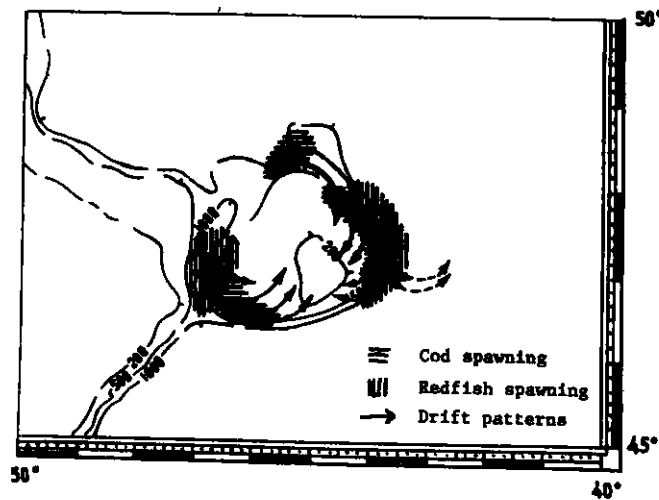


Fig. 4. Spawning grounds of cod and redfish and the drift patterns in the Flemish Cap area.

The spawning of cod on Flemish Cap Bank starts 15-25 days earlier and lasts longer than in the Labrador-Newfoundland area (Serebryakov, 1967). This can most likely be attributed to the fact that the reproduction of *Calanus finmarchicus*, which occurs during the biological spring months, occurs earlier in the Flemish Cap Bank than in the Labrador-Newfoundland area. Semenova (1964) considers that there are two generations of *C. finmarchicus* produced on Flemish Cap Bank. These two generations would provide food for the larval cod over a long period of time and consequently contribute to the survival of larvae from protracted spawning periods, compared with the situation in other areas.

The closed cycle of passive migrations results in the isolation of fish populations occurring on Flemish Cap Bank from those on the Grand Bank of Newfoundland. Cod and redfish are identified as local stocks which differ from the stocks of the neighbouring areas of the Labrador and Newfoundland Banks (Templeman, 1976).

Larvae drift occurs near areas of oceanic depths and insignificant variations in current intensity can change the drift pattern. As a result larvae can be carried into areas with unfavourable conditions for survival and growth. Along the southeastern, eastern and western slopes of Flemish Cap Bank, some cod eggs and larval redfish may be carried to non-productive areas over oceanic depths. In other regions, such as the Faroe Islands or Georges Bank, where a closed cycle of passive migrations is observed in a small area situated near oceanic depths, the size of the off-bank drift can determine fluctuations in year-class abundance (Carruthers, 1951; Chase, 1955; Saville, 1956, 1965). It is most likely that the abundance of cod and redfish year-classes on Flemish Cap Bank is determined by the intensity of the off-bank drift and the consequent loss of larvae from the system.

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