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Factors which may have contributed to the relatively lower inshore cod catches in certain areas in 1985 and 1986

by

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Abstract

Inshore cod catches in NAFO Div. 2J3KL have been declining since 1982 in spite of an increasing total stock biomass of cod 4 years of age and older and also of the age 4-7 year-old-cod which form the bulk of the inshore cod catch and especially the cod trap catches. The below average temperatures in the cold intermediate layer of the Labrador Current may have acted as a thermal barrier discouraging cod from migrating inshore during 1985 but on the other hand the about normal temperatures in this layer in 1986 would not appear to have had an unusual effect on the inshore migration of cod in that year. During 1985 and especially so in 1986 the very large proportionate biomass of immature capelin remaining in the offshore area might have provided a larger food supply offshore and reduced the inshore migration of cod. A further reason for decreased catches could be a decrease in fishing effort for cod occasioned by the increases of capelin licences in Div. 3K and 3L and increases in the supplementary crab licences in Div. 3K.

Résumé

Les prises de morue provenant de la pêche côtière dans la Division 2J3KL de l'OPANO déclinent depuis 1982 malgré une augmentation de la biomasse du stock total de morues de 4 ans et plus, y compris des morues de 4-7 ans qui forment la plus grande partie des prises de morue de la pêche côtière, et particulièrement de la pêche de la morue aux trappes. Les températures inférieures à la moyenne enregistrées dans la couche froide intermédiaire du courant du Labrador peuvent avoir agi comme barrière thermique et empêché la morue de migrer vers la côte en 1985; par contre, les températures à peu près normales dans cette couche en 1986 n'ont pas semblé avoir un effet inhabituel sur la migration de la morue vers la côte au cours de cette année-là. En 1985, et particulièrement en 1986, on a observé une biomasse proportionnelle très importante des capelins immatures qui demeuraient au large; il est possible que la présence d'une source d'alimentation plus grande au large ait eu pour effet de réduire la migration de la morue vers la côte. La diminution des prises pourrait également s'expliquer par une diminution de l'effort de pêche dirigé contre la morue qui résulterait d'une augmentation de l'attribution des permis de pêche au capelin dans les Divisions 3K et 3L et des permis supplémentaires pour la pêche au crabe dans la Division 3K.

Lear et al. (1986) have listed a number of factors which could cause annual variation in inshore catches of cod in Labrador and eastern Newfoundland (NAFO Div. 2J, 3K, and 3L). The following is a short discussion of some factors which may have contributed to the relatively lower catches in certain areas in 1985 and 1986.

1) Stock biomass of cod 4 years of age and older.

Even though the level of inshore catches may show considerable variation, with a stable stock size, there is a degree of correspondence between the 2J3KL biomass of 4+ cod and inshore catches, especially during 1962-74. During 1977-84 the relationship has changed but generally there were increased inshore catches from 35,000 t in 1974 to 116,000 t in 1982 when the 4+ biomass increased from 566,000 t to 977,000 t (Baird and Bishop 1986). The most recent estimate of the 4+ biomass is that for 1985 (Baird and Bishop 1986), estimated at about 1.2 million tonnes. This level of biomass should theoretically contribute to an inshore cod fishery in the vicinity of 100,000 t, based on historical performance, provided that the levels of effort in 1985 and 1986 were consistent with those prevailing during 1982, 1983, and 1984 when 115,621, 106,124, and 97,300 t respectively were landed (Baird and Bishop 1986). The estimates of biomass of 4+ cod during these 3 years were 977,000, 1,097,000, and 1,226,000 t respectively. The inshore catches in these years were about 10% of the 4+ biomass. Thus on the basis of biomass alone, the inshore fishery should be expected to be successful, i.e. in excess of 100,000 t. Therefore, the current estimates of biomass for the entire stock rule out the 4+ biomass as a possible cause of the recent failures in 1985 and 1986.

2) Biomass of 4-7 year old cod.

Pinhorn (1986) demonstrated a significant correlation ($R^2 = 0.71$) between the numbers of 4+5-year-old cod and the total inshore cod catches during 1974-84 and a highly significant correlation ($R^2 = 0.90$) between the numbers of 4+5- year-old cod and the cod trap catches for 1974-84 (excluding the 1979 datum). Catches of cod inshore are composed predominantly of 4-7-year-old cod (Baird and Bishop 1986) and increases in the biomass of 4-7-year-old cod would be expected to lead to concomitant

increases in inshore catches. Biomass estimates of 4-7-year-old cod in 2J3KL have been increasing since 1977 as shown in the following table:

Year	4-7 Biomass (t)
1977	333,400
1978	498,800
1979	678,000
1980	723,400
1981	621,800
1982	717,200
1983	788,300
1984	943,000
1985	954,300

Based upon Pinhorn's (1986) findings the inshore cod catch in NAFO Div. 2J, 3K, and 3L should have an increasing trend since 1981. There was a dramatic increase in catch from 80,074 t in 1981 to 113,049 t in 1982 but there has been a constantly declining trend in inshore catches since 1982 in spite of increasing biomass estimates of ages 4-7-year-old cod.

Clearly the increasing levels of biomass of 4-7 year old cod are capable of supporting a reasonably stable inshore fishery and the reasons for declines in overall catches must lie in areas other than total biomass of 4-7-year-old fish.

3) Labrador current temperatures (100-170 m)

Subsurface temperatures on the Grand Bank at latitude 47°N were about 0.6 to 1.6°C in 1978-79, but below 0°C in 1982-85 (Akenhead 1986). The area of water below -1 degree on the eastern edge of the Grand Bank, corresponding to the 'cold core' of the Labrador current, increased by a factor of 5, steadily from 1978 to 1983 and did not noticeably recede after that. The decline in temperatures involved a drop of 3°C from about 2°C in 140-180 m in 1978 to about -1°C in 1982-85 at the same depth. Those areas on the Grand Bank which were refuges for fish avoiding sub-zero water in 1978-80 were inundated with cold water in the 1982-85 period. Lear et al. (1986) found that the proportional cod trap catch in Statistical Area B to F (Cape St. John to Cape Race) (Fig. 1) during 1975-84 was influenced by the relative abundance of 3-year-old to 2-year-old capelin). The Areas B to F fishery also responds to both temperature in the core of the Labrador current and to surface temperatures, with warm core temperature and cool surface temperatures corresponding to good fisheries. During April and May 1985, the temperatures in 100-170 m at Station 27, near St. John's were very low, well below the long-term average. During 1986 the temperatures at 100-170 m during April were above those of 1985 but still well below the long term average. Similarly for May 1986, temperatures in the core of the Labrador current, measured at Station 27, were below average but about 0.2°C above 1985.

The below average temperatures in the Labrador current may have acted as a thermal barrier discouraging cod from migrating inshore during 1985 but to a lesser extent during 1986.

4) Mature vs. immature capelin stocks.

Lear et al. (1986) analyzed inshore catches from codtrap, gillnets, and handlines/longlines during 1975-84 and attempted to extract relationships among inshore catches and several environmental and biological attributes using principal component analyses. For the cod trap fishery in eastern Newfoundland (Statistical Areas B to F), the proportional trap catch was influenced by the absolute and relative abundance of 3-year-old capelin (relative to 2-year-old capelin) implying reasonable fisheries when both 2- and 3-year-old capelin indices were low and a poor fishery when 2-year-old (immature) capelin were abundant.

The fishery in Labrador and the Great Northern Peninsula was largely influenced by the absolute and relative amounts of 3-year-old capelin and to some extent with surface temperature.

The St. Mary's Bay fishery varied inversely with 2-year-old capelin and to a lesser extent with 3-year-old capelin.

During 1982-84, the biomass estimates of 2-year-old capelin in NAFO Div. 3L were low (27,000 to 128,000 t) (Miller 1986). The biomass of 2-year-old capelin was 1,975,000 t in 1985 which, in 1986 as 3-year-old capelin, were estimated from acoustic surveys to amount to 2,649,000 t. Of the 2,649,000 t of 3-year-old capelin, only 33% were expected to mature in 1986 resulting in a stock of immature 3-year-old capelin of 1,775,000 t plus a stock of 392,000 t of 2-year-old capelin in 1986 (total of about 2,000,000 t of immature capelin) (Table 1). These immature capelin would have remained offshore.

The presence of this enormous food supply on the Grand Bank probably inhibited the inshore migration of cod during 1986 especially. The very low temperatures and large biomass of 2-year-old capelin were possibly two of the major causes of the inshore fishery failure in 1985. Certainly a plentiful supply of food offshore must reduce the necessity of a long migration to the coast since food is readily available in suitable temperatures. This situation optimizes the energy budget of the cod in that less energy is expended than if they had to migrate long distances and break through the cold intermediate layer of the Labrador current to reach the shallow coastal zone.

If this hypothesis is correct, then cod should be plentiful offshore during autumn 1986 and indices of abundance should be higher than usual, especially on the northern Grand Bank.

5) Ice cover

Early ice-free conditions generally contribute to an enhanced fishery in Labrador and northern Newfoundland (Lear et al. 1986). During 1985 the ice was late in receding from the coasts of eastern Newfoundland and Labrador. Cape Freels was not free of ice until June 5 while Cape Bauld was not free until July 3. The persistence of ice on the coast physically delays the operation of the fishery using fixed gear and almost eliminates fishing activity until the disappearance of the ice. Thus the late start of the fishery during 1985 and the loss of landings during May-June may be partially responsible for lower than average landings in 1985.

During 1986 the ice disappeared off Cape Frels on April 20 while Cape Bauld was ice free on May 11.

Thus there was no obvious cause for a delayed fishery in 1986 because of a persistent ice cover late in the fishing season. The inshore cod fishery could have proceeded relatively unimpeded by ice after early May on the northeast coast and from early April in Div. 3L. In summary, ice cover may be partly responsible for low catches in 1985 but certainly not so in 1986.

6. Level of fishing effort

The inshore cod catch is a function of the proportion migrating inshore and the proportion of those inshore actually caught in the inshore fishery. The proportion of those inshore which are actually caught is a function of fishing effort and catchability. During 1985 and again in 1986 there has been a very extensive fishery for capelin in eastern Newfoundland, especially in Div. 3K and 3L during June and early July at a time when cod traps are generally in peak production and the major effort has historically been for cod. There are no available indices of catch per unit effort in the inshore cod fishery by gear type or indeed of overall effort in terms of number of gear units actually fished.

During the past several years (1983-86), the numbers of capelin licences issued in the Newfoundland Region have increased from 858 in 1983 to 1798 in 1986.

These significant increases in effort and catches in the capelin fishery must have been accompanied by a shift of fishing effort away from the cod trap fishery since the major increase in the capelin licences was in the fixed gear (trap) fishery for capelin.

The numbers of licences and catches of capelin during 1983-86, provided by Resource Management Division are as follows:

Year	NAFO Div.	Purse seine	Fixed gear	Capelin catches (t)
1983	3K	43	213	3768
1984	"	49	268	7118
1985	"	51	269	6710
1986	"	64	771	13433
1983	3L	138	432	25020
1984	"	134	439	33260
1985	"	133	426	25451
1986	"	145	707	46109
1983	3P	5	25	146
1984	"	7	48	1133
1985	"	7	43	96
1986	"	7	100	1929
1983	2J3KLP	186	672	28934
1984	"	190	757	41511
1985	"	191	739	32257
1986	"	216	1582	61471

Another possible cause of reduced effort among the gillnet fleet in Div. 3K could be the increased activity in the supplementary crab fishery in 1985 and to an even greater degree during 1986. Figures supplied by the Resource Management Division indicate that 96 licences were granted during 1985 of which 86 were actually used. The fishing season during 1985 extended from August 15 to October 15.

During 1986, 175 supplementary crab licences were issued to fishermen in Notre Dame and White bays. During May 1-June 15 and September 1-October 4 these fishermen caught approximately 1500 t of crab. It is difficult to quantify how much this fishery diverted activity from the groundfish gillnet or trap fishery since the fishermen who fished crab on the supplementary licences may also have fished groundfish gillnets concurrently.

REFERENCES

Akenhead, S. A. 1986. The decline of summer subsurface temperatures on the Grand Bank, at 47°N, 1978-85. NAFO SCR Doc. 86/25. Ser. No. N1139. 8 p.

Baird, J. W., and C. A. Bishop. 1986. Assessment of the cod stock in NAFO Divisions 2J+3KL. NAFO SCR Doc. 86/47, Ser. No. N1163. 50 p.

Lear, W. H., J. W. Baird, J. C. Rice, J. E. Carscadden, G. R. Lilly, and S. A. Akenhead. 1986. An examination of factors affecting catch in the

inshore cod fishery of Labrador and eastern Newfoundland. Can. Tech. Rep. Fish. Aquat. Sci. 1469: iv + 71 p.

Miller, D. S. 1986. Estimates of capelin (Mallotus villosus) biomass from hydroacoustic surveys in Divisions 3LNO in 1985 and 1986. NAFO SCR Doc. 86/79, Ser. No. N1200. 11 p.

Pinhorn, A. T. 1986. Relationship between inshore cod catch and abundance in the 2J3KL cod stock. NAFO SRC Doc. 86/23, Ser. No. N1137. 3 p.

Table 1. Spring (April-May) Div. 3L acoustic survey biomass estimates by year-class (from Miller 1986).

	Age					
Survey year	1	2	3	4	5	6
Numbers (billions)						
1982	<0.1	9.9	16.0	2.4	0.7	0.2
1983	<0.1	3.5	1.9	0.7	<0.1	<0.1
1984	0.1	21.0	6.1	3.2	0.5	<0.1
1985	<0.1	367.4	82.0	4.8	1.8	<0.1
1986	0	63.7	168.1	22.6	0.8	0.4
Weight ('000s tons)						
1982	<1	50	327	61	21	6
1983	<1	27	36	21	2	6
1984	<1	128	117	93	15	<1
1985	<1	1975	1255	136	59	<1
1986	0	392	2649	618	24	14

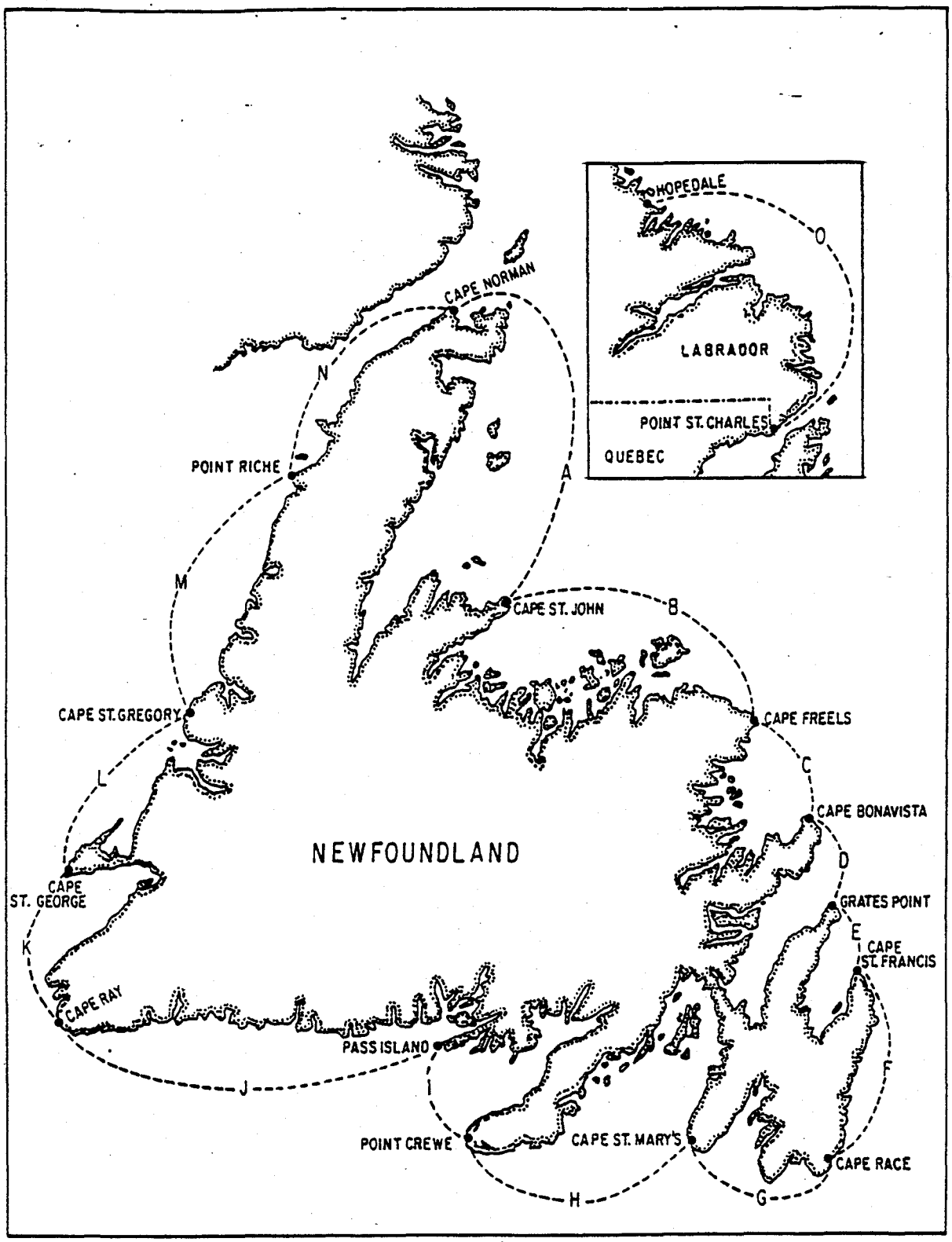

Fig. 1. Area map of Newfoundland and Labrador (inset) showing Sea Fisheries Areas referred to in the text.