

# STOCK STATUS REPORT

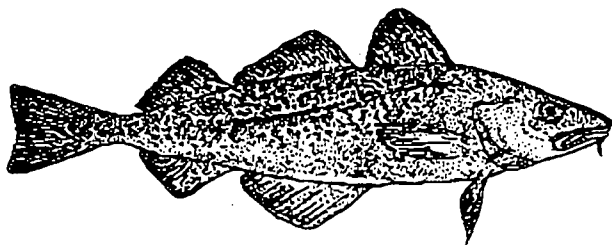
## LAURENTIAN REGION

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## COD IN THE NORTHERN GULF OF ST. LAWRENCE



place. In summer, the cod scatter into more coastal waters along the west coast of Newfoundland (Division 4R) as well as along the Middle and Lower North Shore of Quebec (Division 4S). This coastal mi-gration is influenced by warmer waters and the presence of capelin on which the cod feed.

### Landings (thousands of tonnes)

Year	1991	1992 <sup>1</sup>	1993 <sup>1</sup>	1994 <sup>1</sup>	1995 <sup>1</sup>	1996
TAC	35	35	18	0	0	0
Landings	32	29	18	0.4	0.1 <sup>1</sup>	

<sup>1</sup> Provisional statistics

## INTRODUCTION

Cod in the northern Gulf of St. Lawrence (Divisions 3Pn4RS, Figure 1) undertake large annual migrations. In winter, the cod gather southwest of Newfoundland at great depths. During April and May, the cod head towards the Port au Port Peninsula on the west coast of Newfoundland (Division 4R) where spawning takes

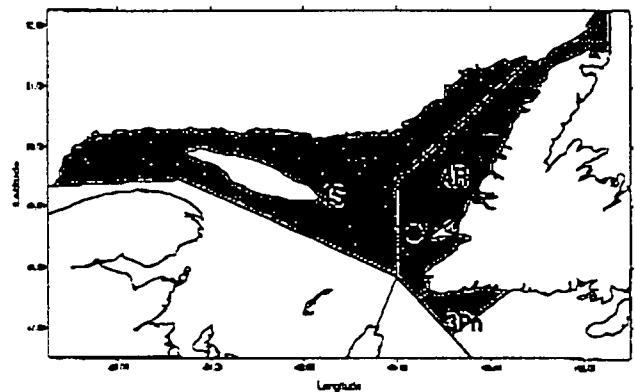


Figure 1. Range of the cod stock in the northern Gulf of St. Lawrence. The circle indicates a spawning ground identified in 1994 and 1995.

This stock is relatively well isolated from other neighbouring stocks (4T,

2J3KL and 3Ps) according to the results of many tag-ging experiments. At times, some mixing may occasionally take place in the north-western Gulf (with the 4T stock), in the Strait of Belle Isle (with the 2J3KL stock) and on the Burgeo Bank (with the 3Ps stock). Studies are currently underway to attempt to determine the extent of this mixing.

## DESCRIPTION OF THE FISHERY

Before the closure of the fishery in 1994, this stock was fished by two types of fleets, the mobile-gear fleet (mainly trawlers) and the fixed-gear fleet (longlines, gillnets and traps). Landings by the fixed-gear fleets decreased more rapidly than their allocated proportion of the total allowable catch (TAC), falling from 50,000 t in 1983 to 8,000 t in 1993 (Figure 2). Catches by the mobile-gear fleet decreased because of a reduction in their allocation, falling from 62,000 t in 1984 to 10,000 t in 1993.

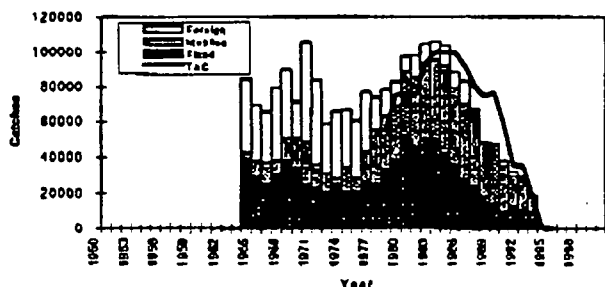


Figure 2. Landings and total allowable catches (TAC).

The different gears used in the cod fishery catch fish of different size, because of their selectivity and the availability of fish to the gear operate. Traps, which are set nearshore, capture the smallest fish, whereas otter trawls

and longlines take fish of intermediate sizes. Finally, the gillnets capture the largest fish.

In 1994, the Department banned all directed fishing on 3Pn4RS cod following recommendations by the Fisheries Resource Conservation Council (FRCC), which cited low biomasses and lack of significant recruitment.

The bycatches of cod in other fisheries are very low, especially now with the closure of the directed redfish fishery and the mandatory use of the Nordmore grate in the shrimp fishery, which excludes approximately 95% of cod. The few groundfish fisheries that remained open in 1995 targeted other species, such as lumpfish, flatfish and dogfish. Gillnets and longlines were the main gear used. The abundance of cod in these fisheries has led to several closures. Some fishermen were using a fishery for one of these species as a pretext to direct their efforts towards cod.

## BIOLOGICAL CHARACTERISTICS

Cod is a species that exhibits wide variations in growth rates. In warmer waters (e.g., Georges Bank) cod have much higher growth rates than in cold waters (e.g., Labrador). Cod in the northern Gulf of St. Lawrence has one of the lowest growth rates of cod stocks on Canada's east coast. In addition, both growth and size at maturity have recently decreased (Figure 3). In 1990, 50% of females were mature at 48 cm, while this size fell to 41 cm in 1994. For males,

the size at which 50% of individuals were mature dropped from 41 cm in 1989 to 36 cm in 1994.

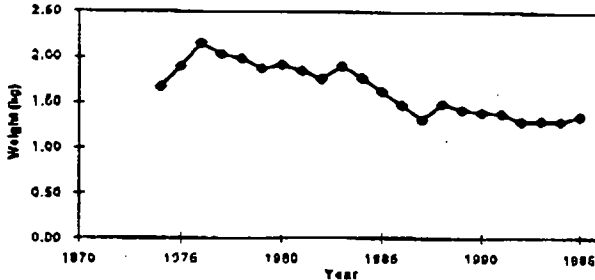


Figure 3. Annual changes in the average weight of 7-year-old cod between 1974 and 1995.

**Condition of cod**

Slower growth is a reflection of a certain amount of stress on individuals. However, if the stress persists or increases, it may also lead to a deterioration in condition of cod. The condition is the relationship between the length and the weight of a fish. A significant deterioration in cod condition was observed between 1989 and 1994 (Figure 4). The conditions observed after spawning in 1993 and 1994 were close to the critical thresholds at which significant mortality in the laboratory is observed.

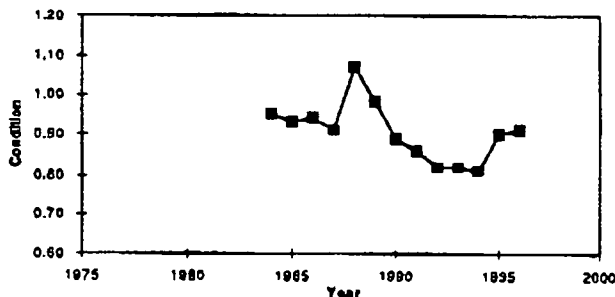


Figure 4. Annual changes in cod condition.

In 1995, the condition of cod has significantly improved. Samples obtained du-

ring the sentinel fisheries (both fixed and mobile gears) and research surveys show that cod condition was at high levels by the end of the summer 1995. The values that were observed were similar to the maximum seen under laboratory conditions when cod are fed at will.

**Cod diet**

Differences in condition may be related to differences in diet. The energy value of a diet depends on the type and quantity of prey ingested, with fish providing the greatest energy. In 1995, stomach samples were taken during the summer survey and the sentinel fisheries.

Large inter-annual variations in feeding both in terms of total weight of the prey ingested and their energy content have been noted. Data are not available for all years, but for those years when they are available, the maximum amount of food ingested occurred in 1983, the quantities were average during the 1990s, and at a minimum in 1978. Fish dominated in samples obtained from sentinel fisheries with fixed gear, while invertebrates dominated in the stomachs of cod from mobile-gear catches.

**Spawning**

An aggregation of spawning cod was observed off St Georges Bay in May 1994. Many eggs were present in the water column above the aggregation of cod. A similar observation was made in 1995. However, the fish did not seem to be spawning and very few eggs were sampled. No other aggregations were found during an intensive search in the western part of the Gulf, either because

they did not exist or because they form at other times than that of the survey (early May). The results from 1995 indicate that the period when aggregations form varies from year to year and that the spawning aggregation is not stable. The biomass within the cod aggregation seems to fluctuate significantly from day to day and cod scatter into smaller groups once spawning begins.

Hydroacoustic surveys on these aggrega-

### ABUNDANCE INDICES

We have two abundance indices for cod, the bottom trawl survey, which has been carried out on the Alfred Needler in August-September since 1990, and the sentinel fisheries. These began at the end of 1994 and it is still too early to make any multiyear comparisons that could reveal any trends for the stock. A survey was also previously carried out in winter on the Gadus Atlantica, but in the past few years it has proved inadequate for esti-

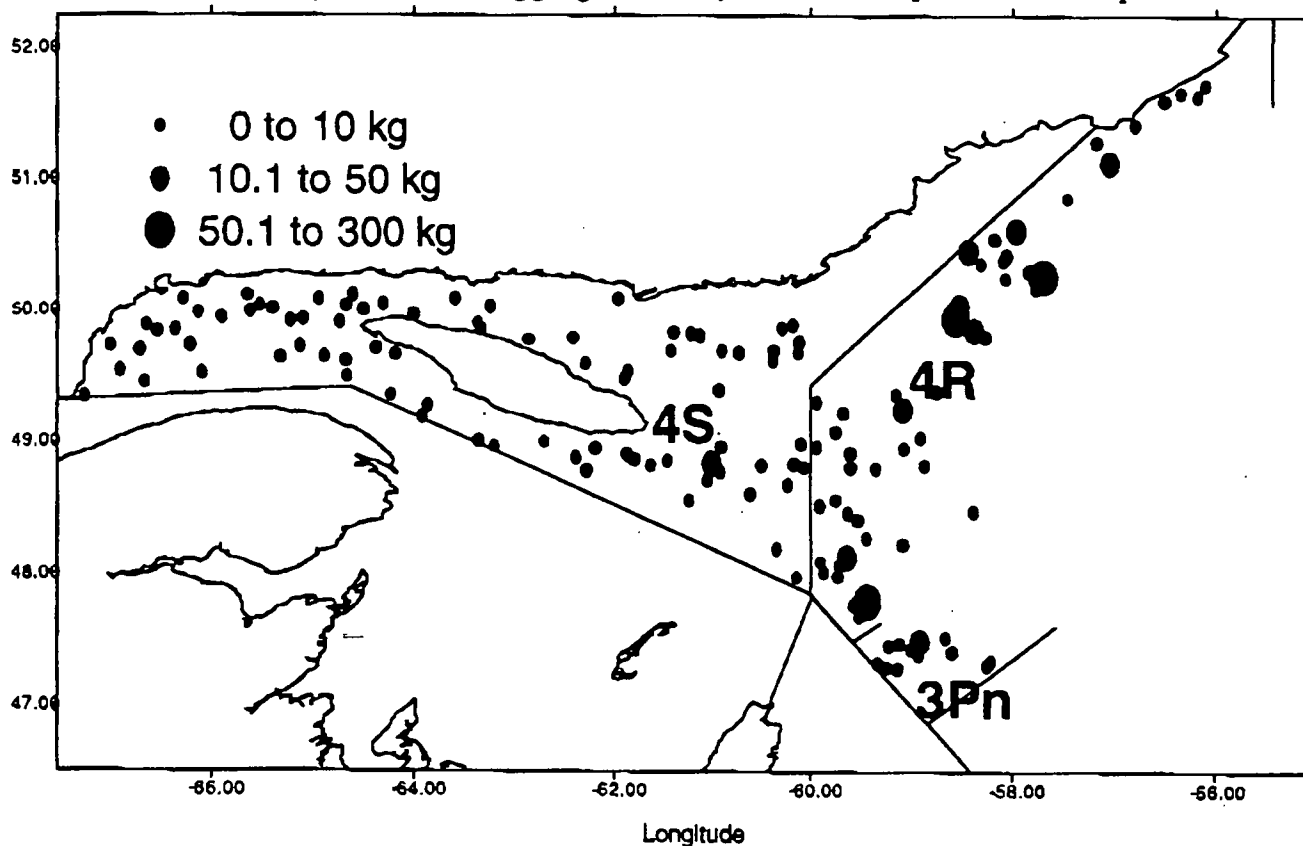


Figure 6. Map of yield distributions during the summer survey on the Alfred Needler in August-September 1995.

tions of spawners could be a source of information about the adult component of the stock.

mating the abundance of cod because of mixing with 3Ps and was abandoned in 1994.

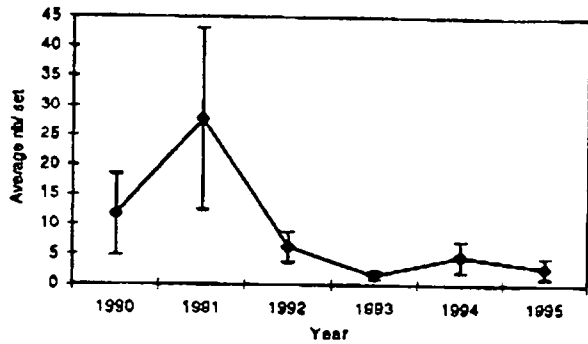


Figure 5. Abundance index (average number per haul) from the summer survey. The vertical lines indicate the 95% confidence intervals.

**Bottom trawl surveys**

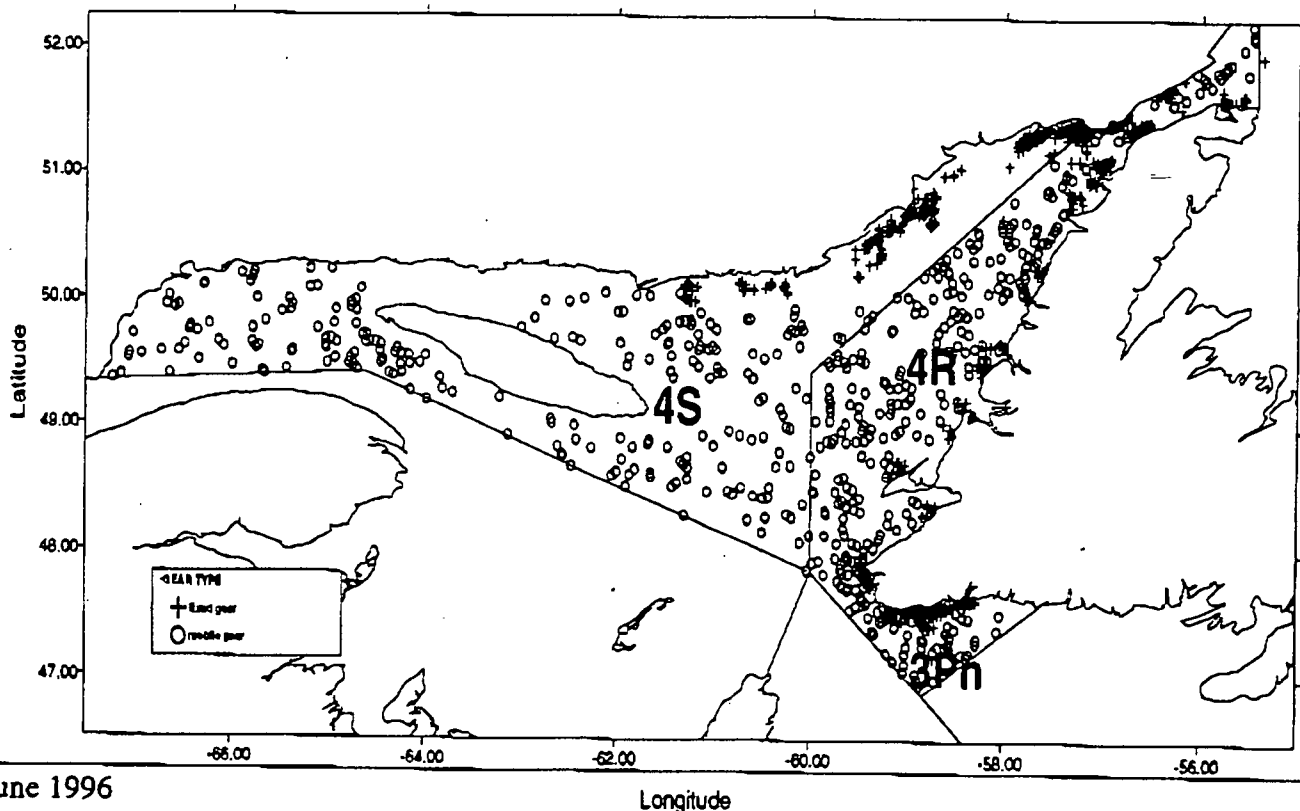
The summer survey, originally designed in 1990 to assess Gulf shrimp and redfish populations, was modified the following year to better cover the range of cod in the northern Gulf. The abundance index, expressed in average numbers per haul, decreased by 65% between 1992 and 1993, and by 93% between 1991 and 1993 (Figure 5). This

was mainly due to the rapid disappearance of the 1986 and 1987 year-classes. The abundance index was thus at its lowest in 1993 and has not changed much since then.

No strong year-classes have been observed during the survey since 1992. Cod caught in 1995 came from the northern part of Division 4R (the west coast of Newfoundland) (Figure 6), while in 1990 and 1991, they were also distributed in 4RS (Lower North Shore of Quebec).

**Sentinel fisheries**

The FRCC recommended setting up sentinel fisheries to monitor changes in the cod stock during the closure. The program began in a limited way in the fall of 1994 and was expanded in 1995 with a greater variety of gear (gillnets, traps and hand lines) and the addition of four trawlers from Quebec in Division 4S.



June 1996

Longitude

Figure 7. Sentinel fishery sites. The crosses (+) represent sites fished with fixed gears, the open circles (O) the sites fished with mobile gear.

*Sentinel fisheries with fixed gear*

Two separate projects were carried out in 1994 and 1995, one on the west coast of Newfoundland (4R and 3Pn) and the other on the Lower North Shore (4S). In order to take advantage of fishermen's knowledge of the spatial and temporal distribution of cod, they were encouraged to continue fishing using traditional techniques. In 1994, these objectives were only partially attained, since projects were approved very late in the year.

The coverage of the sentinel fisheries program increased substantially between 1994 and 1995. In 1994, there were only 185 fishing trips, involving 56 fishermen, at 20 sites, while in 1995, 102 fishermen made a total of 1,697 fishing trips at 42 different sites (Figure 7). All of the biological samples were collected by the fishermen themselves.

The best gillnet yields were obtained in the northern part of Division 4R in September, reaching 140 kg per net. The best longline yields were obtained in the southern part of 4R and in 3Pn between October and December, peaking at 700 kg for 1,000 hooks.

*Sentinel fisheries using mobile gear*

Four seasonal surveys have been carried out to date. The first two were limited to 4R and 3Pn, while the last two covered the entire stock area (3Pn and 4RS) (Figure 7). The trawlers made a random stratified survey similar to those carried out by DFO research vessels. A liner in the codend also allowed sampling of younger fish to assess recruitment.

The size distribution of cod fished during the first survey (December 1994) showed two modes, the first consisting of individuals from the 1990 and 1991 year-classes and the second of individuals from the 1987 and 1988 year-classes (Figure 8). The same year-classes were found during the second survey (April 1995). During the last two surveys (August and October 1995), a significant change in the age structure was observed. In August, yields for the 1987, 1988 and 1990 year-classes fell by almost half; only the 1991 year-class did not change. In October, the 1992 and 1993 year-classes were large, while the abundance of all other year-classes decreased. We have no explanation for the absence of these year-classes during the last survey.

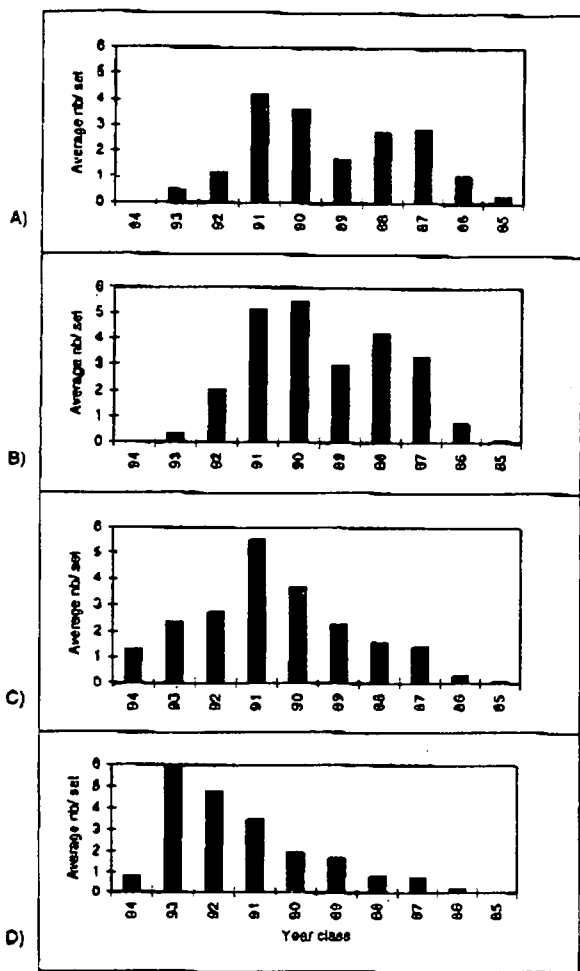


Figure 8. Age structure (average catch in number per tow) of sentinel fisheries using mobile gear (A=Dec. 94, B=April 95, C=Aug. 95, D=Oct. 95).

Although the catchability of cod on the Alfred Needler is much less than on sentinel fisheries because of the gear used, towing speed and the duration of the hauls, the distribution and the size composition of cod observed during the two surveys in August were similar.

### INFORMATION FROM THE INDUSTRY

Again in 1995, a number of discussions took place with the industry, either during information sessions on the state of the resource or during FRCC public hearings. In addition, during a five-day tour along the west coast of Newfoundland and Labrador, we asked fishermen participating in the sentinel fisheries program for their impressions of the state of the resource. The fishermen frequently mentioned that the cod seemed to be in excellent condition. They generally recognized that yields were insufficient to support a commercial fishery. In their view, consumption by seals continues to be one of the main causes of massive mortality in cod.

### STATE OF THE RESOURCE

In the latest assessments of the stock, the estimated exploitation rate ranged from 30 to 40%, which represents a fishing mortality level well beyond the target level  $F_{0.1}$  (16%). Given the absence of sufficient commercial data, it was impossible to make a detailed analysis this year.

The sentinel fisheries detected marked differences in the conditions and diet of the fish caught near the shores with fixed gear and of those caught offshore with mobile gear. The 1996 sentinel fisheries should enable us to assess these differences more clearly.

In the last two assessments of the stock, cold water temperatures were associated

with the poor condition of the cod. Results of studies done at the Maurice Lamontagne Institute suggest that the poor condition of cod has caused a decrease in biological production by lowering growth and by reducing recruitment. The poor condition may even have caused an increase in natural mortality in adult fish. The situation has considerably improved in 1995, the condition of cod being now at high levels. This could lead to improved growth and recruitment. However, the effect of these changes, if they persist, will not be felt in the short term. The abundance of the stock is still extremely low and the new year-classes (1991, 1992 and 1993) entering the adult population are also small.

The abundance index from the Alfred Needler research surveys for the past four years has been relatively stable. The stock biomass remains low, but the decline experienced in the early 1990s appears to be over. We continue to be concerned about the absence of 1990 and 1991 year-classes in the last sentinel fisheries survey using mobile gear.

Several new abundance indices are being developed. The sentinel fisheries and hydroacoustic surveys are new initiatives that should provide new information about the state of the resource.

**For more information :**

Fréchet, Alain, P. Schwab, M. Bérubé, C. Rollet, G. Moreau, Y. Lambert, D. Chabot, Assessment of the northern Gulf cod stock (3Pn, 4RS) in 1996. DFO Atl. Fis. Res. Doc. 96/62.

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