DFO Atlantic Fisheries
Stock Status Report 95/5E

Original

Compilation of the Reports on the Status of Groundfish Stocks of the Gulf of St. Lawrence

Science Branch
Institute Maurice-Lamontagne
Department of Fisheries and Oceans
P.O. Box 1000
Mont-Joli, Québec G1K 7Y7

Science Branch
Gulf Fisheries Centre
Department of Fisheries and Oceans
P.O. Box 5030
Moncton, New Brunswick E1C 9B6

June 1995

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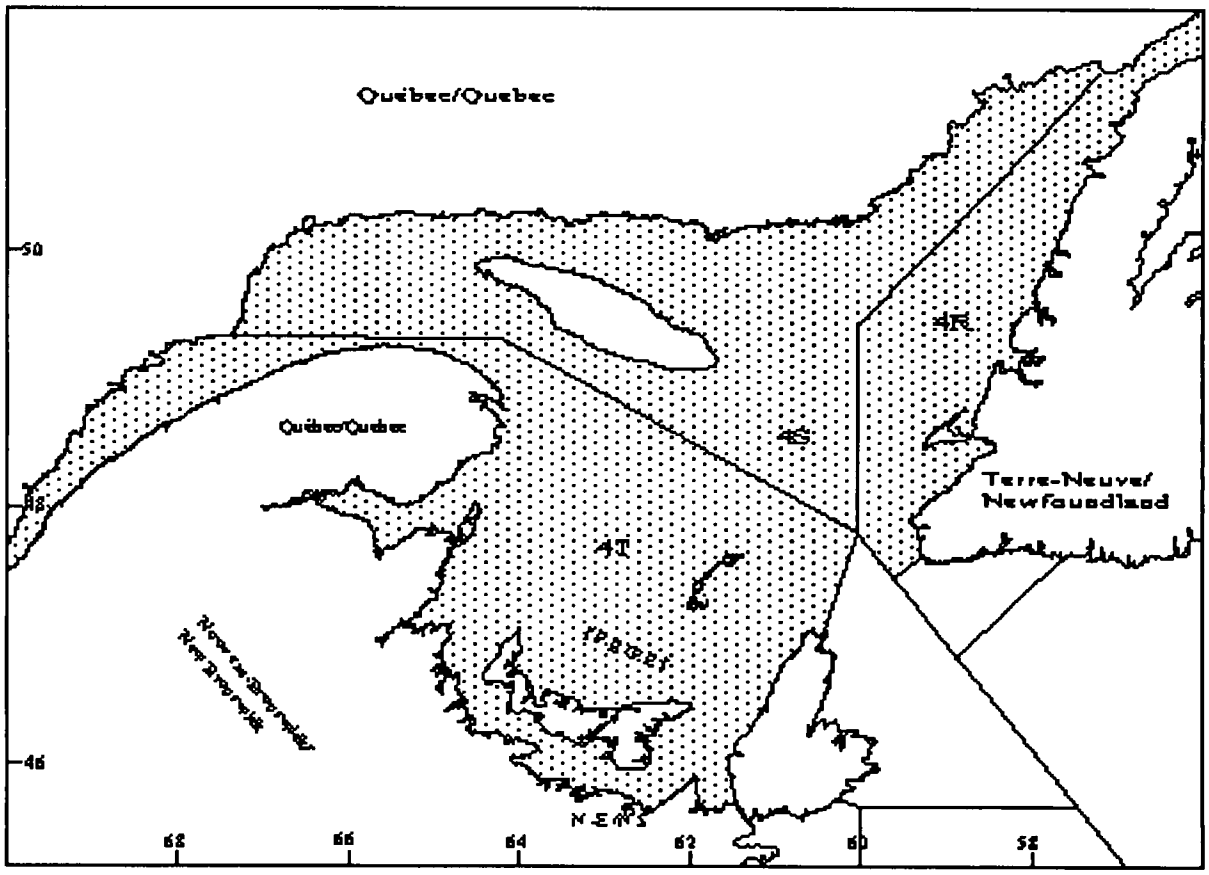
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Introduction

This report is a compilation of material produced by the Science Branches of the Institute Maurice LaMontagne (IML) and the Gulf Fisheries Center on Gulf of St. Lawrence groundfish stocks.

The Gulf Region material is part of a larger report that covers all aspects of their regional review process, from the formation of assessment teams, through the extensive consultations with industry and the stock assessments. The report will summarize the 1995 regional review of marine fish and invertebrate stocks in the Gulf Region mostly found in the southern Gulf and will be produced in the DFO manuscript report series.

The larger Quebec Regional report is a product of regional reviews that were held in April with fisheries and scientific managers. Extensive regional consultations with industry took place during the fall of 1994 and winter of 1995 in preparation for the report.

The complete Quebec Region report will include herring, mackerel and capelin and will be produced as a DFO manuscript report.

For more information on either of these reports please contact:

Mike Chadwick
Science Branch
Gulf Fisheries Center
Fisheries and Oceans
P.O. Box 5030
Moncton, N.B. E1C 9B6
Telephone: 506-851-6206

Serge Labonté
Science Branch
Institute Maurice LaMontagne
Fisheries and Oceans
P.O. Box 1000
Mont-Joli, Quebec G1K 7Y7
Telephone: 418-775-0637

1. REGIONAL OVERVIEW
Gulf of St. Lawrence - Québec Region

1.1 Introduction

Quebec Region is responsible for the management of seven Gulf of St Lawrence fish stocks, the others falling under the Gulf Region. The Regional Stock Assessment Committee held a number of meetings between April 11, 1995, and May 11, 1995 to study the status of fish stocks in the Gulf of St Lawrence. This regional review was the second to be held at the Maurice Lamontagne Institute since the Canadian Atlantic Fisheries Scientific Advisory Committee (CAFSAC) was disbanded in 1992.

The Maurice Lamontagne Institute conducts research in oceanography and on the stocks of fish, invertebrates, and marine mammals in the Gulf and eastern Arctic Ocean. In particular, a multidisciplinary team is currently carrying out a major research project on cod to determine the relationships between production (growth, reproduction, etc.) and the climate of the Gulf of St Lawrence. In its examination of stock status, the regional committee looked at the results of this research and combined them with more traditional assessment methods to determine the status of stocks. In this regard, the committee examined three documents that described (1) the climate of the Gulf as presented to the Fisheries Oceanography Committee, (2) the importance of fish condition measurements as indicators of stock status, along with recommendations, and (3) the sentinel fisheries program. The following fish stocks were reviewed:

- Northern Gulf of St Lawrence **cod** (NAFO divisions 3Pn, 4R, and 4S)

  Head of assessment team: **Alain Fréchet**

- **Redfish** in Gulf of St Lawrence Unit 1 (NAFO divisions 4R, 4S, and 4T, + 3Pn-4Vn [Jan.-May]

  Head of assessment team: **Bernard Morin**

- **Turbot** (also known as Greenland halibut and black turbot) in the Gulf (NAFO divisions 4R, 4S, and 4T)

  Head of assessment team: **Bernard Morin**

- **Atlantic halibut** in the Gulf (NAFO divisions 4R, 4S, and 4T)

  Head of assessment team: **Diane Archambault**

- **Herring** in the northern and western Gulf (NAFO divisions 4R and 4S)

  Head of assessment team: **Ian McQuinn**

- Gulf of St Lawrence **capelin** (NAFO divisions 4R, 4S, and 4T)

Head of assessment team: **François Grégoire**

- Northwest Atlantic **mackerel** (NAFO subregions 2-6)

  Head of assessment team: **François Grégoire**

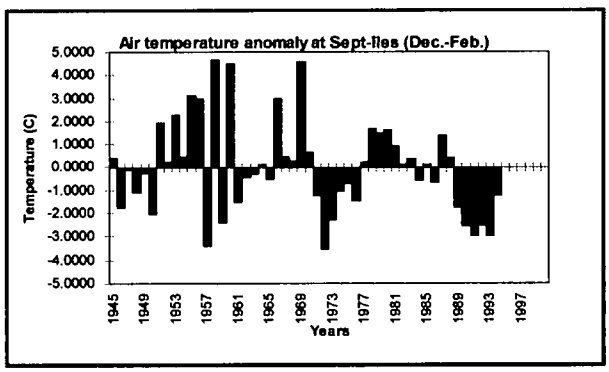
The committee reviewed information on redfish and mackerel. The assessments of Unit 1 and 2 redfish depend heavily on the results of trawl surveys carried out in August-September of each year. Last year the FRCC issued advice on the redfish stock based mainly on the results of the last survey and not on the stock status report produced the previous May. At this time, there is actually no additional information that would make it possible to issue a new assessment. The stock status report on redfish will be published after the 1995 survey but interim material is contained in this report. Meanwhile, the Department has set up an inter-regional multidisciplinary research group to study major problems affecting Atlantic redfish stocks. A working group, composed of representatives of the Newfoundland, Scotia Fundy, and Quebec regions, identified the main gaps in our knowledge of redfish and examined the available data. A report prepared jointly with the industry will lay the foundations of multidisciplinary research program on redfish.

Mackerel is a migratory species that spends part of the year in U.S. territorial waters. The Americans will be making an assessment of the stock this spring, and we have been invited to participate. The stock status report on mackerel will be completed when the U.S. figures are available and have been assessed.

1.2 State of the environment.

The results presented in this section are taken from the annual report on the physical oceanographic conditions in the Gulf of St. Lawrence. The air temperatures are taken from the *Climatic Perspectives* published by the Atmospheric Environment Service. Examination of the ice cover is based on the weekly charts published by Ice Central of Environment Canada in Ottawa. Finally, vertical profiles of temperature and salinity collected during the bottom trawl surveys conducted in August-September on the Alfred Needler were used to yield information on the cold intermediate layer, September bottom temperatures in the southern Gulf, and layer averaged temperatures and salinities.

Air temperature



For the period from October 1993 to November 1994, the most striking result is the much colder than average air temperatures which prevailed during the winter. In the

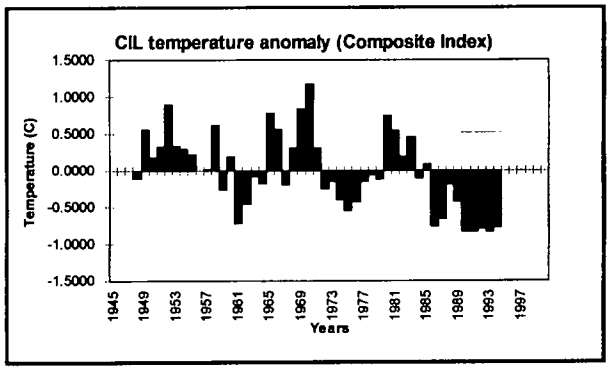
western Gulf, the coldest month was January 1994 (6°C below normal), whereas in the eastern Gulf, the coldest month was February 1994 (5.5°C below normal). The winter average air temperature at Sept-Îles were below normal for the last six winters . For the other seasons, the air temperature at Sept-Iles was 1.2°C colder than normal in the spring, close to normal in the summer, and 1.5°C above normal in the fall of 1994.

Sea ice

In the early winter of 1994 (December 31, 1993 and January 15), we see that the ice edge (solid line) was between the median (dashed line) and maximum (dotted line) ice edge positions for the 1962-1987 period. On February 01, 1994, the ice edge was close to the maximum ice edge position, and even exceeded it along Nova Scotia's eastern shore. On March 01, 1994, the ice edge was again very close to the maximum ice edge position. Finally, during the period of ice retreat (April 01 and May 01, 1994), the ice edge was again located between the median and maximum ice edge positions. Overall then, we may say that the 1994 winter was characterized by heavier than average ice conditions, consistent with the colder than average winter air temperatures which prevailed over the Gulf.

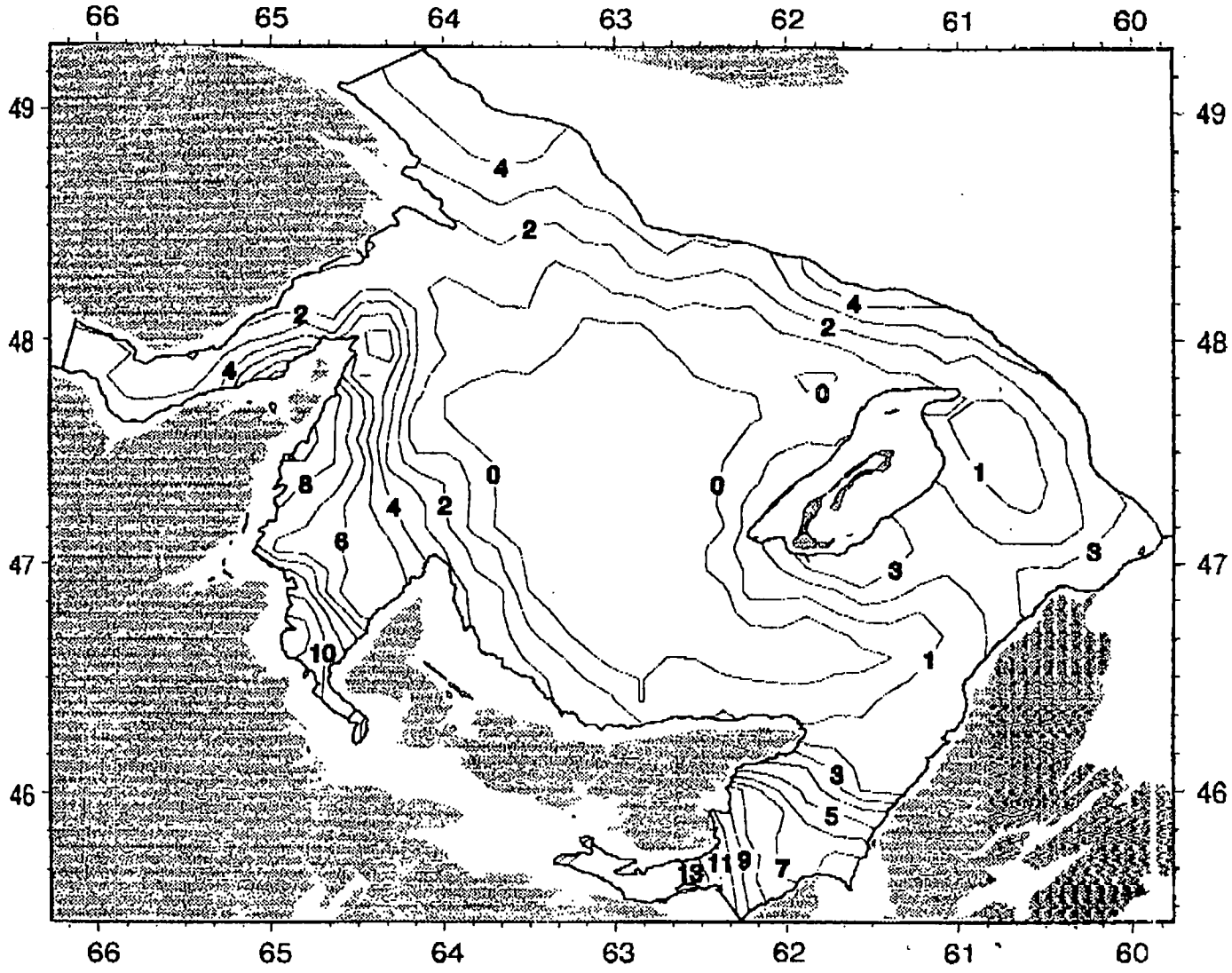
Cold intermediate layer

As implied by the word "intermediate", the cold intermediate layer (CIL) is a layer of cold water (close to 0°C), roughly 30 to 125 m (17-70 fathoms) deep, with warmer water both above and below it. The last five years, from 1990 to 1994, have been exceptionnally cold. In 1994, the maximum cold intermediate layer thickness was found in the northeast Gulf, as in 1991 to 1993, while the smallest thicknesses were found in the Cabot Strait region and in the Estuary.



September bottom temperature in the Southern Gulf

Bottom temperature in September 1994 was lowest in the central region of the Magdalen Shallows and increased shoreward and with depth along the Laurentian Channel. Bottom temperature was less than 1°C over 39% of the survey area and less than 0°C over 20% of the area. Subzero bottom temperatures thus extended over a relatively large area of the southern Gulf in 1994, continuing the period of cold bottom conditions that began in 1990.

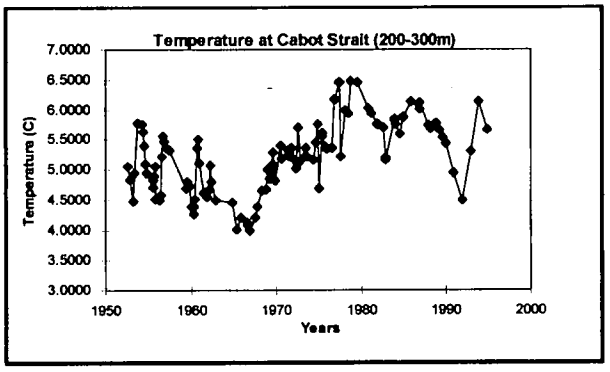


Temperature at the bottom in the southern Gulf in September 1994

Temperature in the deeper waters of the Gulf

In the **0 to 30 m (0-17 fathoms) layer**, the 1994 temperatures were colder than in 1993, particularly so along Québec's north shore. Satellite pictures of sea surface temperature show that those large differences are due to the very prolonged and intense upwelling of cold water which occurred along all of Québec's north shore throughout most of August 1994.

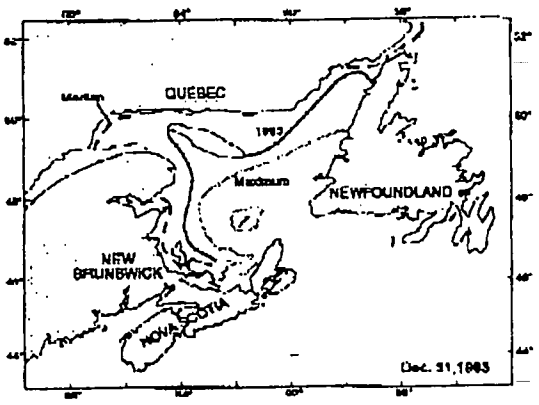
In the **30 to 100 m (17-55 fathoms) layer**, which roughly coincides with the depth range of the cold intermediate layer, the temperature (average = 0.36°C) was colder than normal by more than 1°C throughout most of the Gulf. Below this, warming occurred from 1993 to 1994 in both the **100-200 m and 200-300 m (55-110, and 110-165 fasthoms) layers** almost everywhere in the Gulf, so that the temperatures are now slightly above normal (averages 2.6°C and 5.4°C respectively).



The temperature increase from 1993 to 1994 ranged between about 0.6°C and 1.1°C in the 100-200 m layer, and between 0.2°C and 1.2°C in the 200-300 m layer. The only region where cooling occurred is Cabot Strait, where the cross-channel average temperature decreased by 0.6°C in the 100-200 m layer, and decreased by 0.5°C in the 200-300 m layer. A similar 0.5°C drop in the cross-channel average temperature of the 200-300 m layer was also observed at the Cabot Strait section during November 1994, after two successive years of warming.

Summary

The highlights for 1994 are that: **1)** winter air temperatures were below the 1961-1990 normal for a sixth consecutive winter, **2)** the ice cover was above the 1962-1987 median areal extent, **3)** the cold intermediate layer was colder than normal for a ninth consecutive year, **4)** intense upwelling occurred along Québec's north shore during the month of August, and **5)** the deep layers (100-200 m and 200-300 m) warmed everywhere in the Gulf, except in Cabot Strait where the temperatures dropped by about 0.5°C.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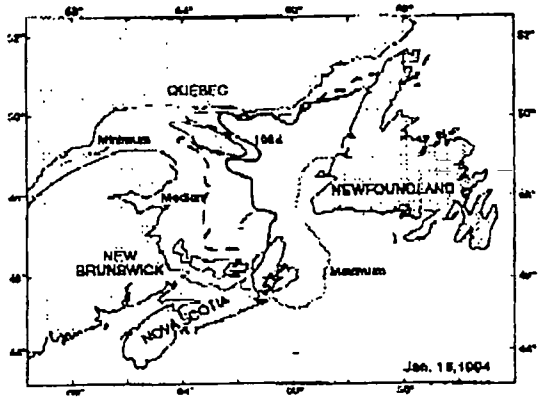
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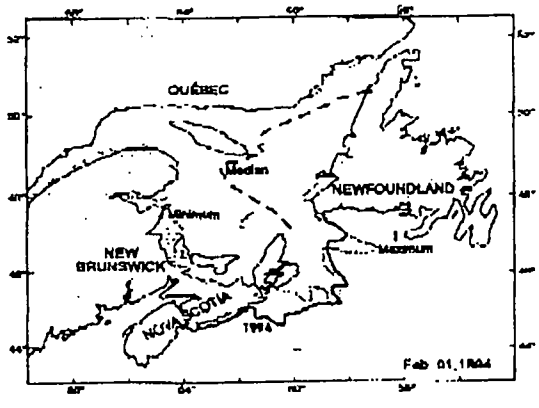
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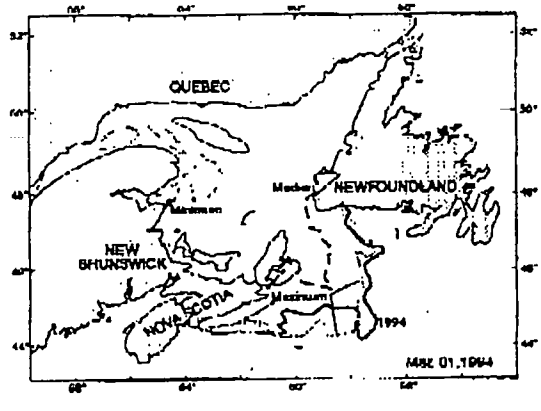
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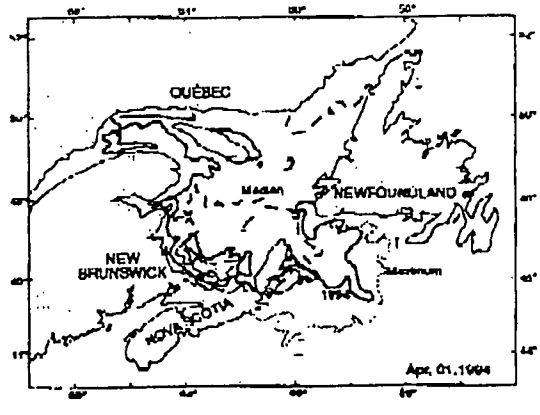
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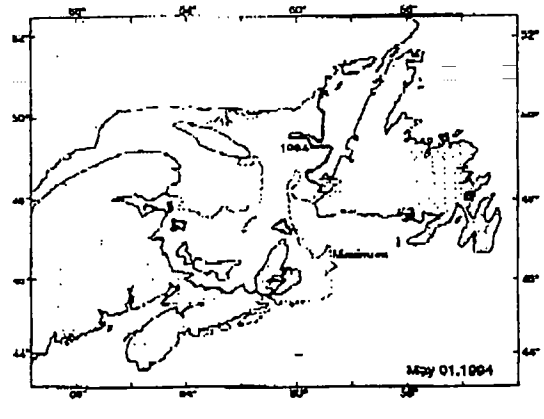
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1.3 Summary of the status of the Gulf of St. Lawrence resources

Our knowledge of the biological communities of the Gulf of St Lawrence is mainly based on commercial species, since records have been kept on them for long periods, while information on the other species is sporadic and fragmentary. Stocks of invertebrates and pelagic fish in the Gulf of St Lawrence are, with a few exceptions, all in good shape with biomasses near or above long-term averages. Groundfish stocks, on the other hand, are generally in poor condition, at levels close to and even below record lows. Four of these stocks, including the three largest (the two cod stocks, and the redfish and white hake stocks), are now closed to all directed commercial fishing.

Crustaceans

Three species of crustaceans are fished intensively in the Gulf of St Lawrence: northern shrimp, snow crab and lobster. These species occupy different habitats in the Gulf ecosystem.

Shrimp remain near the bottom during the day at depths of 180 to 250 m. There are four main concentrations in the Gulf, namely in the estuary, west of Anticosti Island, north of Anticosti Island and in the Esquiman Channel. The shrimp biomass in the Gulf increased systematically from the early 1980s until 1990, then decreased slightly. Recruitment currently observed in the population suggests that the shrimp biomass will remain stable and perhaps even increase in the short term. Shrimp is a major prey for redfish and cod when they are present on grounds used by this species.

Snow crab live at medium depths (100 m) on relatively soft bottoms. The life cycle of this species is particularly complex. The fishery targets mature males measuring over 95 mm, which recruit to the fishery around age 10 in the northern Gulf. The crab biomass is currently very high, but a major decrease is expected to begin in 1995, since the 1985-1987 year-classes are weak. The subsequent year-classes (1989-1992) appear strong, and the biomass should begin to increase again in 1999. Similar phenomena have been observed in the past, and the low landings in 1987-1989 might be due to the presence of relatively weak year-classes born in 1977-1979. These fluctuations appear to be linked to biological mechanisms that are internal to the crab populations and relatively independent of weather conditions.

Lobster live on fairly rocky bottoms near the coast. Landings in Quebec, as in the entire Atlantic Region, have increased steadily over the past 20 years, although some decline (10-15%) was seen in 1992 and 1993. Lobster catches are essentially based on annual recruitment, and this constant increase is attributed to a combination of oceanographic factors and the increased capacity of the fishing fleet. Although few recruitment indices exist, there are indications of a downward trend for the next few years.

Molluscs

We have much less information on molluscs, which are generally harvested on a small scale, with little or no regulation. The only Quebec

mollusc population for which we have a long record is Magdalen Islands scallops. This population is very heavily fished, and the biomass is at a very low level, with the fishery being sustained only by annual recruitment.

Fish

Herring is the most sought-after pelagic species. There are two herring spawning stocks, spring spawners and fall spawners. As is the case for all pelagic fish, recruitment of herring varies significantly from year to year. In the northern Gulf, the herring biomass was at its lowest level in the early 1980s, after a period of many years during which recruitment was low. The strong 1982 year-class allowed the biomass to increase rapidly up until 1989-90, after which it declined despite relatively strong recruitment in 1986-87. The spawning stock biomass remains at relatively high levels; however, the spring spawner component in Bay St George is now very low, partly due to relatively intense fishing aimed specifically at this component.

Mackerel is a summer visitor to the Gulf. In the winter, the mackerel gather on the edge of the continental slope off New England and Nova Scotia. In summer, a large portion of this population comes into the Gulf to spawn (June-July); after spawning, the mackerel scatter to such areas as the Gulf and Grand Banks to feed. The young mackerel grow very rapidly, and at the end of their first summer, when they have reached a size of about 20 cm, they migrate out of the Gulf to spend the winter in the open sea with the adults. This migration pattern results in a net export of biological production out of the Gulf, since the mackerel biomass is probably close to a million tonnes. The mackerel biomass is currently very high and since, after extension of the fishing limit to 200 miles, fishing by Canada and the U.S. has been very low, fluctuations in abundance are mainly due to fluctuations in recruitment. Over the past 30 years, two year-classes (1967 and 1982) have been particularly abundant and permitted the mackerel biomass to increase considerably. Since the mid-1980s, the mackerel biomass has declined slowly since there have been no such pulses of recruitment. The 1988 year-class might be strong, but the low exploitation rate gives us no way to accurately assess its abundance.

Capelin is another major pelagic species in the Gulf, but it is not extensively harvested; there is only a small fishery in the northwestern Gulf. The capelin biomass is presumed to be large, but no information is currently available on its abundance and variations. Capelin is the main prey for cod in the northern Gulf, as well as for seals and summer visitors such as rorquals. Capelin is presumably also targeted by many other predators in the Gulf.

The groundfish fishery in the Gulf of St Lawrence is dominated by three groups of species: Gadidae (cod north and south of the Laurentian Channel (3Pn4RS and 4TVn stocks [Nov.-April] and white hake), redfish (Unit 1 – 4RST, 3Pn4Vn[Jan.-May]) in the deep waters of the Laurentian Channel, and flatfish (American plaice on the Magdalen Shelf, turbot in the western Gulf and the St Lawrence estuary, witch flounder along the west coast of Newfoundland and in 4T, and winter flounder

in coastal waters). Cod fisheries have traditionally dominated landings in the Gulf of St Lawrence but, due to reductions in TACs, cod represented only 28% of groundfish landings in the Gulf in 1993. Redfish accounted for 60% of landings in 1993. Landings of other species, which are often by-catches in the cod fishery (such as American plaice and white hake) also declined.

Cod and redfish migrate every year between their wintering areas around Cabot Strait and the interior of the Gulf in summer. Although these migrations have been common knowledge for some time, analyses in early 1994 showed that the extent and period of these migrations might vary considerably from year to year. In particular, it became clear that cod from the southern Gulf began migrating out of the Gulf in November, earlier than had previously been assumed, and the management unit has thus been modified accordingly. These analyses also demonstrated that many other species gathered in the Cabot Strait area in winter (e.g. white hake, turbot) and that their distribution was often continuous with that of populations from outside the Gulf, indicating that current management units may not be appropriate for all these species.

Fluctuations in Gulf cod have followed those for most other Northwest Atlantic stocks, particularly the more northerly stocks (northern cod on the St Pierre Bank and the eastern part of the Scotian Shelf). After a period of great abundance in the mid-1960s, the two stocks dropped to very low levels in the mid-1970s, and then rose until the mid-1980s following several years of very strong recruitment. After that, stocks basically collapsed, reaching record low levels in 1992-1993. Until quite recently, harvesting rates for these stocks have been very high and have increased gradually over the past decade, while the growth rate of individuals has decreased during the period. This reduction in growth, and the increasing scarcity of large fish that has resulted, have led to an increase in the number of small fish (under 41 cm) being discarded by the commercial fishery.

Intense harvesting combined with a decrease in biological production has brought about a catastrophic decline in cod stocks. The two components of production -- individual growth and recruitment -- have both decreased greatly since the mid-1980s. Cod are generally found at medium depths which, as we have seen, have cooled considerably over the past ten years. It is assumed, although this cannot be confirmed, that this cooling of water masses has created environmental conditions unfavourable to cod. In fact, weather conditions appear so unfavourable that the very condition of the fish (see next section) has deteriorated to the point where their survival is in jeopardy. The same deterioration in condition has been observed in herring and turbot, thus supporting the idea that environmental conditions play a role in fish condition. A major research program has thus been set up to identify the causes.

The redfish stock is in fact made up of two separate species (*Sebastes fasciatus* and *Sebastes mentella*). Effective methods of distinguishing the species have been developed in recent years, and biological differences are beginning to be recognized (distribution, reproduction) between the species, but the

effect of these differences has not yet been established. Redfish in the Gulf appear to be closely linked to those of the Laurentian Channel (3P4V). This stock, and thus its fishery, have been dominated by the sporadic appearance of strong year-classes (particularly those born around 1946, 1956-58, 1970 and 1980), while recruitment was practically nil during other years. The succession of these year-classes in the population has resulted in significant variations in catches. A recent year-class, born in 1988, does not appear to have persisted in the Gulf, and will probably not be able to contribute to the fishery in the future. Since there has been no significant recruitment since the early 1980s, and this year-class was heavily fished, the redfish biomass has decreased considerably, and there is no likelihood of a recovery until 7 or 8 years after significant recruitment has been observed.

Redfish live in the deep waters of the Gulf which, contrary to surface waters, have tended to be warmer than average over the past decade. The growth and condition of redfish do not appear to have changed, but since 1980 there has basically been no significant recruitment to the Gulf redfish population. The environmental conditions which may have affected redfish populations have probably acted independently of those that affected cod since these two species occupy water masses with highly different dynamics.

With the exception of turbot, flatfish stocks do not appear to experience such pronounced fluctuations. After a period of relative abundance during the 1960s and early 1970s, flatfish stocks declined slightly, but have remained relatively stable since. The abundance of American plaice varies over relatively long cycles and at one point seemed to be inversely related to that of cod. The species' abundance is now below average. The fishery is characterized by a serious discard problem. Turbot differs from other species of flatfish by substantial fluctuations in abundance, once again linked to marked variations in recruitment (by a factor of more than 5 between lowest and highest). Harvesting of this population is intense, and fishing success depends essentially on recruitment. The decrease in cod TACs has made winter flounder more attractive. This species occupies primarily coastal habitats and there are probably several separate populations in the Gulf. In the southern Gulf (4T), the abundance of this species does not appear to vary widely, although declines have been noted in certain locations (particularly in the Magdalen Islands).

Marine mammals

Four species of seal (harbour, hooded, grey and harp) are abundant in the Gulf of St Lawrence.

The grey seal population of the Gulf has grown at the rate of 8 % a year, and grey seal also breed on Sable Island outside the Gulf. The production of young seals in the latter population was in the order of 10,000 newborns in 1990, and is increasing at the rate of 12.6 % par year. Some Gulf seal spend part of the year outside the Gulf, while a few Sable Island animals spend part of the year in the Gulf. Quantitative information on diet and

distribution are incomplete. Some information is available from the northern Gulf (May-September) since the mid 1980s, and throughout the year in 4VsW for recent years. Quantitative diet information is not available for other regions including the southern Gulf, 4X, 3P, and 2J3KL. Grey seal consumption of cod in eastern Canada is estimated to have increased from approximately 14,000 t in the early 1980s to approximately 40,000 t in 1993, mostly in the Gulf and on the Eastern Scotian Shelf. Assuming that on average 88 % of the Sable Island herd and 25 % of the Gulf herd remains outside of the Gulf, then total consumption of cod by grey seals in 1993 would be in the order of 18,000 t in the Gulf of St. Lawrence, 17,000 t in 4VsW, and 5,000 t in the remaining areas. The majority of cod consumed by grey seals consists of pre-recruits, with only an estimated 20 % of the fish consumed being large enough (>45 cm) to be taken by the commercial fishery. It is not possible to assess the impact of this consumption by grey seals in the Gulf of St. Lawrence on Gulf cod stocks.

Harp seals are the most abundant pinnipeds in the Northwest Atlantic. In March 1994, an aerial survey was flown to estimate harp seal pup production in the Gulf of St Lawrence and off the east coast of Newfoundland. The results of this survey indicate that pup production has increased from 580,000 (+78,000) in 1990 to 703,000 (+127,000) in 1994 (Stenson et al. 1995a). The 1994 population estimate is 4.8 million animals with a range from 4.1-5.0 million. This estimate could be as low as 4.5 million if pup mortality is assumed to be higher than that of older seals.

Cod consumption by harp seals in the Gulf of St Lawrence was estimated using information on individual energy requirements, population size, diet and the seasonal distribution of animals. In 1994, it was estimated that Gulf harp seals consumed 53,700 t (13,500 t-101,000 t) of cod (Stenson et al. 1995 b). The majority of these cod were juveniles (10-20 cm long), too small to be taken by the commercial fishery. The wide range in current estimates of consumption are due to uncertainties in diet composition and the distribution of animals in the Gulf of St Lawrence. The proportion of cod in the diet of harp seals along the west coast of Newfoundland varies between 9% and 20% while it is less than 2% in the Magdalen Islands and upper estuary. Uncertainties in the proportion of the Gulf population in each of these areas during the time that they are in the Gulf will have a major effect on cod consumption estimates.

Little information is available on the size of the hooded seal population. Production of young hooded seal in 1991 in the Gulf of St Lawrence was approximately 2,000 newborns. No information is available on the diet of hooded seal in the Gulf. Information from the "Front" indicates that these animals feed mainly on capelin, turbot and redfish. Little is known about the relations between the hooded seal in the Gulf and those of the "Front", or on the proportion of juveniles returning to the Gulf in winter.

1.4 Fish condition

Diminished growth and condition in northern Gulf cod have led us to study the mechanisms affecting fish condition. The capacity of a stock to support harvesting by the fishery depends on its productivity, or capacity to produce biomass as the individuals it comprises are eliminated, whether by the fishery or by natural factors. Biomass increases as a result of individual growth and recruitment. When environmental conditions deteriorate, growth slows, so that the weight for a given age decreases, and when environmental conditions worsen, growth slows to the point where fish condition deteriorates. Fish condition is not measured by weight at a given age, but rather by weight for a given length. The condition of a fish reflects its energy content and its relative success in its environment. When the growth rate is low, condition reflects variations in productivity.

A detailed examination was made of the mechanisms affecting growth and condition in northern Gulf cod, and this may serve as an example for regular monitoring of fish condition. When the condition of cod sampled at sea is compared to that of cod subjected to severe environmental conditions, it is seen that fish in their natural environment, at least in the case of Gulf of St Lawrence cod in the 1990s, are in a similar condition in the spring to that of cod that were starving. When the fish in a stock are in such poor condition, their natural mortality rate may change. Models to predict abundance have not to date taken these changes into account, and this may have contributed to underestimation of true mortality. For stocks exposed to severe environmental conditions, it is thus essential to measure fish condition.

While it is simple and economical to measure fish condition, certain rules must be followed. In the case of cod, we set up a specific sampling protocol. Laboratory experiments enabled us to interpret condition data, since we know the range of possible values for each of the variables proposed. Unfortunately, this protocol works only for cod; further testing will be needed before it can be used for other fish species.

1.5 Sentinel fisheries

The sentinel fisheries program is an entirely new approach to assessing stocks. In 1994, the Department banned all directed fishing on 3Pn,4RS cod further to FRCC recommendations based on low biomass and the lack of significant recruitment. Since the closure of the cod fishery in 3Pn,4RS in 1994, the small amount of information available has been obtained from by-catches in the shrimp and redfish fisheries.

Following closure of the directed cod fishery in the northern Gulf (3Pn,4RS) in 1994, and the discontinuation in January 1995 of the winter survey, which had been conducted by the research vessel Gadus Atlantica since 1978, a large amount of information ceased to be available for monitoring these populations, for example information on catches per unit of effort, size structures, growth and recruitment. The information available is essentially limited to the summer survey by the research vessel

Alfred Needler.

It was in this context and in light of the growing willingness to include the traditional knowledge of fishermen in assessments that the sentinel fisheries were introduced. Following discussions between the FRCC and the Statistics, Sampling and Surveys Committee, the sentinel fisheries program was set up to measure certain parameters judged essential to the decision-making process on reopening a closed fishery: (1) abundance of young and adult fish, (2) size structure (at length and at age), (3) biological factors such as condition and diet, and (4) predation by seals.

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Contact/Contacte

D. Gascon
Telephone: 418-775-0631
FAX: 418-775-0542
E-Mail: D_Gascon@Qc.DFO.ca

2. Regional Overview
Gulf of St. Lawrence-Gulf Region

2.1 Introduction

Regional review is a relatively new process designed to examine the scientific basis of the assessment of fish and invertebrate stocks. It also encourages partnerships between scientists and the fishing industry. Last year, regional review was conducted for groundfish and herring stocks in the southern Gulf: Invertebrate stocks were reviewed zonally. Diadromous stocks in the Guf Region have also been reviewed regionally for the first time, February 1995. Previously, all stocks had been reviewed zonally by a scientific committee call CAFSAC (Canadian Atlantic Fisheries Scientific Advisory Committee). This report summarizes the 1995 regional review of groundfish stocks in Gulf Region, mostly foundin the southern Gulf.

2.2 Regional Overview

Introduction

The regional review included marine fish, lobster, rock crab, and snow crab in the southern Gulf. Molluscs and other fish and invertebrates were not reviewed.

Description of fisheries

The cod fishery was closed in 1994. There were directed fisheries for witch, white hake, winter flounder, plaice and dogfish. Regulations designed to limit the by-catch of cod led to several closures. The herring, snow crab and lobster fisheries were prosecuted as usual.

Target

Effort controls should be included with quota management. There are no targets for dogfish and winter flounder.

Fishery data

Input from industry indicated that catch data from groundfish fisheries during the mid 1980's up to the closure in 1992 were unreliable. There were few criticisms of data from crab and herring fisheries, which reported high catches in 1994. There was wide variation in lobster landings around the region; industry felt that landings data were unreliable. There was concern that no formal method had been developed for including index fishers' data in the assessments.

Research data

The annual groundfish survey in September provided abundance estimates for groundfish stocks, which were all at low abundance in 1994, and herring, which were wide-spread. The snow crab survey showed the biomass was high and located near the offshore edge of the distribution. The acoustic survey indicated that small herring were wide-spread but did not find significant schools of adult herring. The juvenile herring survey found young herring to be increasing in abundance. The juvenile cod survey found no signs of new recruitment, which was consistent with the groundfish survey.

Estimation of stock parameters

Formal assessments were conducted for snow crab, cod, and herring. Research surveys were the only information used to estimate absolute snow crab biomass and were the main source of information for the assessments of cod and other groundfish. The estimate of herring abundance depended entirely on catch rates in the inshore gillnet fishery. There was no method to estimate abundance of lobster or rock crab.

Assessment results

Cod has low and stable biomass, and reduced fishing mortality. Abundance of white hake is at the lowest level since 1972 with few older hake and high fishing mortality. Plaice and witch abundance are at very low levels. There appears to be a decline in winter flounder abundance. Spring and fall herring stocks continue to remain at high abundance. Snow crab is also abundant. Lobster landings, which are presumed to track abundance, have declined over the past 4 years.

Ecological considerations

Environmental conditions have been cold since the late 1980's: average winter air temperatures were below average for the sixth consecutive year; the extent of winter ice was greater and persisted longer than normal; the extent of bottom temperature <0 C was greater than average. Freshwater discharge was above average. The 1995 temperature of the cold intermediate layer appears to be below average for the 9th consecutive year. There are some indications that productivity in the southern Gulf has been low for the same time period: mean weight of cod has remained low and mean weight of herring has declined; and recruitment of most groundfish species has been below average. There is some evidence that species interact: small cod and small plaice compete for the same food, mysids; and the 1980, 1983 and 1987 year-classes were strong for both cod and herring. Samples from lobster traps near shore indicate that cod fed almost entirely on bait in the traps.

Future prospects

Poor recruitment is expected for all groundfish and snow crab stocks. There is evidence of a large 1991 year-class of spring herring. Recruitment of lobster is uncertain.

Management considerations

There is some evidence that declines in the above-average 1985-1987 year-classes of cod were due to discarding. White hake overwintering in 4Vn until early June could be caught when the 4Vn fishery re-opens in April. Replacement biomass, for groundfish in particular, would be a better target than yield per recruit because fishing mortality would be reduced when growth is below average. Increases in mesh size should be implemented only when it is assured that there will not be coincident increases in fishing mortality of older fish. Fishing effort should be matched to stock potential and included with the TAC, allowing regulation of fishing effort to be a second means for controlling fisheries. Re-opening the cod fishery with the same fleet size and using the same management approach as when the stock declined would probably result in immediate overfishing.

2.3 Environmental Summary

Environmental conditions in the Gulf of St. Lawrence have been cold since the late 1980s. In 1994, annual air temperatures were slightly colder than normal but warmed in comparison to recent years. Summer and autumn air temperatures were warmer than normal, but winter air temperatures were below the 1961-1990 average for the sixth consecutive year. The cold air temperatures in winter were related to strong northwest winds which carried Arctic air masses south. These stronger-than-normal northwest winds resulted from an intensification of the Icelandic Low, which was reflected in high positive values of the North Atlantic Oscillation (NAO) index.

These cold winter air temperatures and accompanying strong northwest winds caused ice to form early and be of greater areal extent than normal. By early February, the entire Gulf was ice-covered, and ice extended out onto the Scotian Shelf beyond the 1962-1987 long-term maximum. Ice duration was longer than normal (by over 2 weeks) throughout most of the Gulf. New records for ice duration and for the latest date of the last presence of ice were set on the Magdalen Shallows.

Water temperature data collected during the annual groundfish abundance survey of the southern Gulf revealed colder than normal bottom temperatures on the Magdalen Shallows in September. The area of the Shallows with bottom temperatures below 0°C was much greater than normal for the fifth consecutive year (Figure 2.3). Data collected throughout the Gulf in August and September indicated that the cold intermediate layer was colder than normal for the ninth consecutive year. In contrast, temperatures in deep (200-300 m) water at Cabot Strait were above average for a second year.

Discharge from the St. Lawrence River was slightly higher than average in 1994.

Contact/Contacte

G. Chouinard
Telephone: 506-851-6220
FAX: 506-851-2387
E-Mail: ChouinardG@GFC.DFO.CA

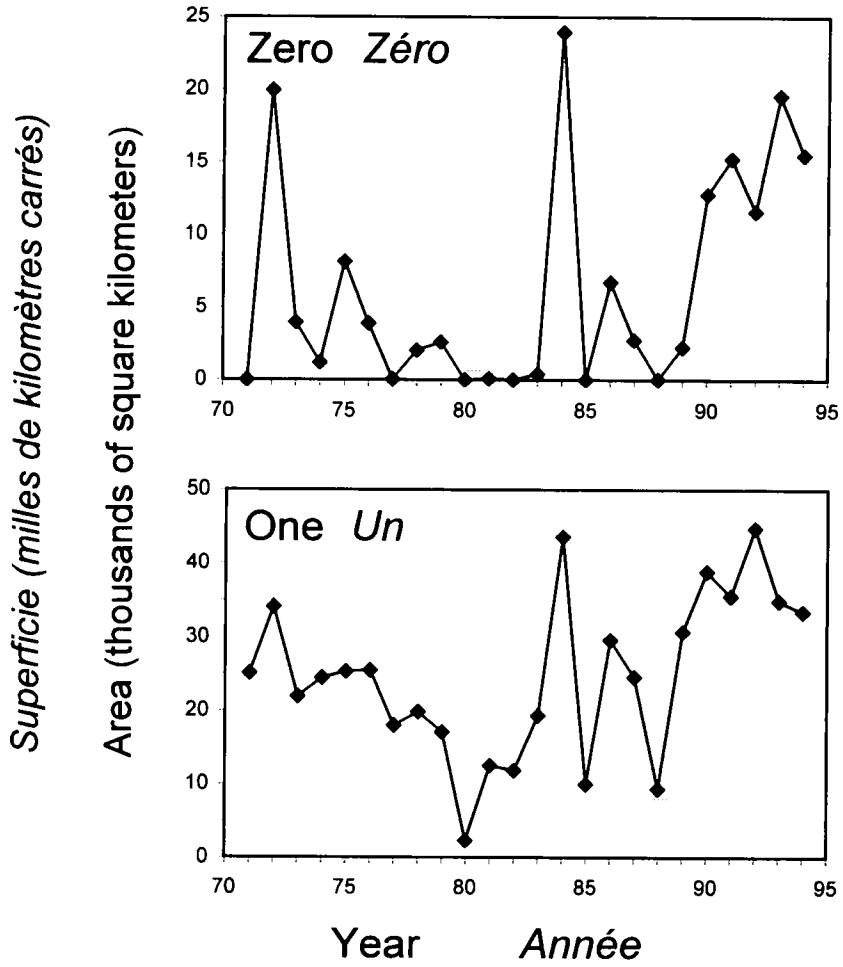
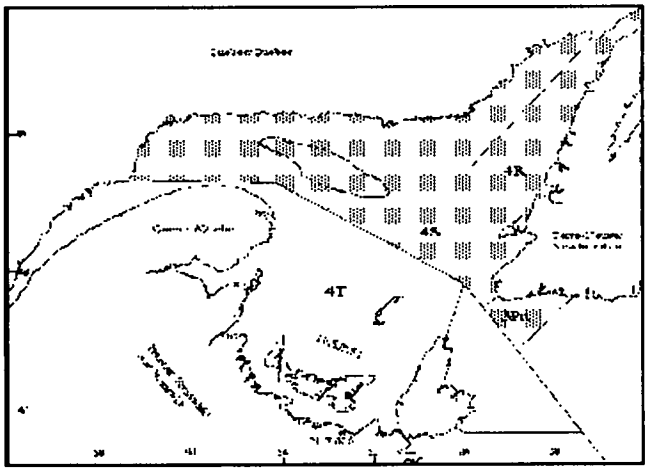


Figure 2.3. Area within the survey region with bottom temperature below 0C and 1C.
Superficie dans la zone du relevé ayant des temperature de moins de 0C et 1C.

3.1 COD - Northern Gulf of St. Lawrence

Introduction

Cod in the northern Gulf of St Lawrence undertake major annual migrations. In winter, the cod gather in the southwestern part of Newfoundland (Division 3Pn) at great depths. During April and May, the cod head toward the Port au Port Peninsula on the west coast of Newfoundland (Division 4R) where spawning takes place. In May 1994, a school of spawning cod was located along the west coast of Newfoundland. 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 migration is basically favoured by warmer waters as well

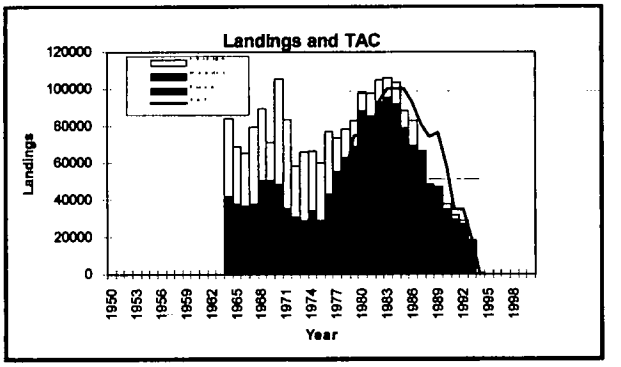


as by the presence of capelin on which the cod feed, and this is a key factor in the success of the trap fishery.

This stock is relatively well isolated from other neighbouring stocks (4T, 2J3KL, 3Ps), according to the results of many tagging experiments. At time, some mixing may occasionally take place in the northwestern Gulf (with the 4T cod stock), in the Strait of Belle Isle (with the 2J3KL cod stock) and on the Burgeo Bank (with the 3Ps cod stock). Several recent studies have attempted to quantify the extent of this mixing.

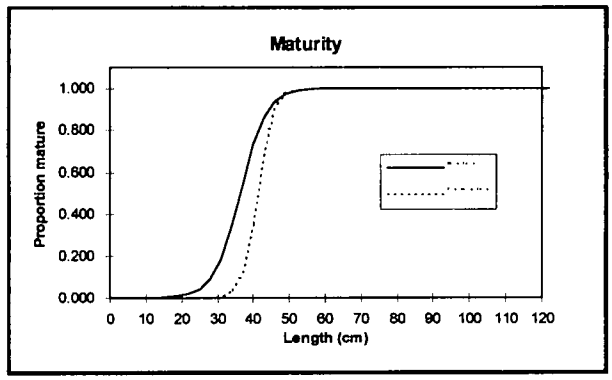
Description of the fishery

Before the closure of the fishery, this stock was fished by two separate fleets, the mobile-gear fleet (mainly trawlers) and the fixed-gear fleet (longlines, gillnets and traps). Landings by the fixed-gear fleet decreased more rapidly than their allocated quotas, falling from 50,000 t in 1983 to 8,000 t in 1993. 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. The selectivity of various types of fishing gear is



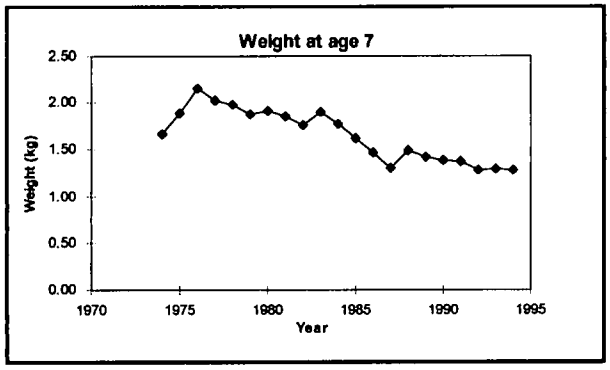
different. Traps catch the smallest fish, trawls and longlines take intermediate size fish, and the largest fish are caught in gillnets.

In 1994, DFO banned all directed fishing on 3Pn4RS cod following recommendations by the FRCC which cited the low biomasses and lack of significant recruitment. With the closure of the 3Pn4RS cod fishery in 1994, the little information available was obtained from by-catches in the shrimp and redfish fisheries. Biological samples are thus rare. Catches were dominated by 6 or 7 year old individuals.



Biological characteristics

Cod is a species that exhibits wide variations in growth rates. In warmer waters (for examples on Georges Bank), cod have much higher growth rates than in cold waters (Labrador).



Cod in the northern Gulf of St Lawrence has one of the lowest growth rates of cod stocks on Canada's east coast. Moreover, both growth and size at maturity have decreased over the past 10 years. Fifty per cent of females were mature at 48 cm in 1990 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.

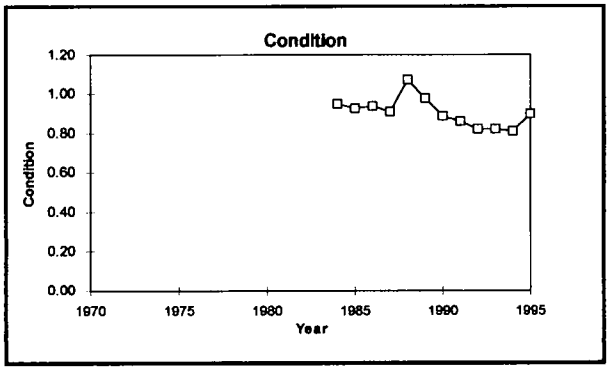
Condition of cod

Two indices were used to determine cod condition. The first is the condition factor (K), which represents the relation between the length and total weight of an individual (less the weight of gonads and stomach contents). This K factor is an indicator of the main protein reserves of the fish. The second, the hepato-somatic index (HSI), represents the relation between the weight of the liver and the total weight of the fish (less the weight of gonads and stomach contents). This factor is an indicator of the animal's main fat reserves.

The general condition of cod in the northern Gulf of St Lawrence deteriorated significantly from 1985 to 1993, and 1994 was no exception since condition levels measured in the spring and fall were lower than those measured in 1993. The minimum condition factor was observed in May (K=0.7), while some cod also had a low hepatic index (HSI=2.2%). In a controlled environment, the prolonged famine led to deaths among cod, whose condition factor (K) varied from 0.4 to 0.7 with an HSI of from 0.3 to 1.4%. These

figures are a strong indication that natural mortality occurred among adult fish following a marked deterioration of their nutritional status during winter 1993-94.

It appears, however, that during the winter of 1994-1995 the condition of cod improved. This at least is suggested by a sample obtained from the sentinel fisheries (mobile gear) in December 1994 (K=0.9, HSI=4.1%). These condition indices show that the cod had



reached a condition level that might be described as good for this period of the year.

Cod diet

Cod diet was examined as part of the sentinel fisheries program from December 1994 to January 1995. Preliminary analyses show that a third of the stomach contents was made up of fish, the remainder being composed of various invertebrates. The most common fish in the diet of cod (by weight) were herring (7%), capelin (3%), Gadoids (6%) and redfish (3%). Among the invertebrates, amphipods were the most abundant (44%), but shrimp (7%) and crab (12%) were also very abundant.

These results differ somewhat from the results obtained from winter surveys conducted at the same time during previous years. From January 1978 to 1994, fish made up over 50% of the mass of stomach contents, particularly in the mid-1980s when they made up 80% of stomach contents. These changes call for more in-depth analysis.

Abundance indices

The FRCC recommended setting up sentinel fisheries to monitor changes in the cod stock during the closure. This program began in the fall of 1994.

Sentinel fisheries with fixed gear

Two separate projects were carried out, one on the west coast of Newfoundland (4R,3Pn) and the other on the Lower North Shore (4S). It should be noted that late approval of these projects had a negative impact on fishing success in 4S and the northern part of 4R. On the Lower North Shore, fishing effort was limited to the use of 20 gillnets with a soak time not exceeding 24 hours. On the west coast of Newfoundland, longlines were used, with the number of hooks being limited to 750. In order to take advantage of the traditional knowledge of fishermen regarding the spatial and temporal distribution of cod for each fishing site, fishermen could fish where and when they chose. This objective was only partially attained, since projects were approved very late in the year.

The fishermen weighed the catches of each species, measured lengths and removed the otoliths from cod.

In Division 4S, only 11 cod were caught during 50 fishing trips between November 14 and December 1. These low catches may be due to the fact that the fishery began after the departure of cod from this area. The few cod landed were nevertheless of good size (55-70 cm), indicating the possibility of resident adult cod. Before the sentinel fisheries experiment, it was generally recognized that only the youngest cod lived in the Gulf in winter (individuals 1 to 3 years old). Sentinel fisheries with fixed gear on the west coast of Newfoundland, which took place from November 28 to January 19, showed two distinct patterns. First, there was a north-south gradient in catch rates, with the best catches occurring in the southern part (4Rd, 3Pn) during the first weeks of fishing. Secondly, catch rates generally decreased in the southern part of the area with the approach of winter, when the cod migrated towards 3Ps or into deeper water.

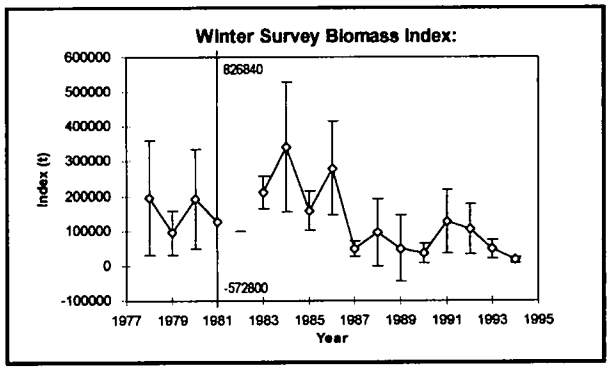
The fish caught by longliners on the west coast of Newfoundland measured 46 to 58 cm, which corresponds to the 1987 to 1990 year-classes.

Sentinel fisheries using mobile gear

In December 1994, five trawlers from the west coast of Newfoundland carried out a survey in divisions 4R and 3Pn similar to those conducted on groundfish by DFO research vessels. It should be noted there was no sentinel fishery in Division 4S and so the estimate of minimum trawlable biomass covers only divisions 3Pn and 4R. There probably were cod in Division 4S, but information from previous surveys indicates that few cod are present in this area in the winter. The estimated minimum trawlable biomass for 4R and 3Pn was 13,800 t. Two modes were seen in the length frequencies of cod caught: one group between 34 and 43 cm corresponding to the 1990 and 1991 year-classes and a second group between 49 and 61 cm corresponding to individuals from the 1986-1988 year-classes.

Research surveys

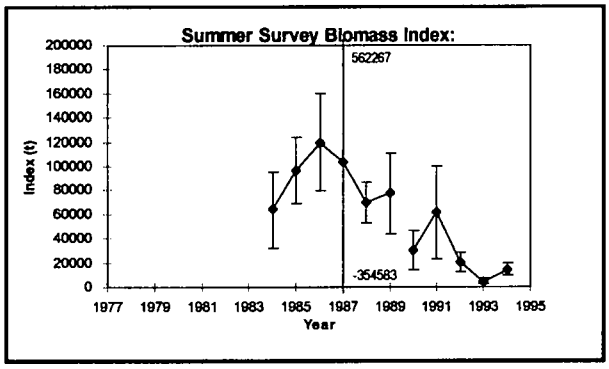
The estimated minimum trawlable biomass obtained in January 1994 during the trawl survey on the Gadus Atlantica was 17,000 t, the lowest of all series since 1978. Biomass estimates have been low since 1987. Over the past few years, the largest concentrations of cod were observed in deep waters in 3Pn. The



January 1994 survey was therefore extended to sample the waters of the Burgeo Bank at depths of over 150 fathoms. If we include cod from this part of Division 3Ps, the biomass estimate would increase by 55%. It is however impossible to determine whether cod detected west of 3Ps were from the northern Gulf stock. Several factors limited the validity and

precision of the winter trawl survey, and it was decided to end this survey in 1994.

The summer survey, originally designed in 1990 to assess Gulf shrimp and redfish populations, was modified in 1991 so as to also estimate the cod stock in the northern Gulf by adding shallow water strata and by sampling 3Pn. The total estimated population obtained from this survey decreased by 65%



from 1992 to 1993 and by 93% from 1991 to 1993. This was mainly due to the rapid disappearance of the 1986 and 1987 year-classes. The summer 1994 survey showed a minimum trawlable biomass of 14,500 t, whereas this biomass had been around 61,000 t in 1991. We nevertheless believe that the biomass estimate from the 1993 survey was inaccurate, as the decrease was noted for many species. The largest year-classes in the summer 1994 survey were those of 1990 and 1991, the same classes that dominated catches in the sentinel fisheries using mobile gear in December 1994.

The age structures observed in the three surveys carried out in 1994 (winter, summer and sentinel fisheries) slowed slight variations from one survey to another, which may be due to a great extent to the selectivity of different mesh sizes used in the three surveys. However, no individuals over 7 years old were caught during any of the surveys, which basically took individuals born in 1990 and 1991.

Assessment

Exploitation rate

In the most recent analytical assessments of this 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%). By-catches of cod by trawlers fishing for shrimp and redfish in 1994 were only 400 t, which is negligible compared to the various estimates of minimum trawlable biomasses obtained from surveys and the sentinel fisheries. Given the lack of commercial data, it was impossible to conduct a sequential population analysis.

Information from the industry

A number of discussions took place between scientists, fishermen and industry representatives during the past year. Contacts were made during the many public FRCC hearings, and at research program review meetings held by the MLI. There were frequent meetings of biologists, technicians and fishermen to plan the sentinel fisheries program. The general industry perception of the status of the resource is very similar to that of scientists: the biomass of this stock is very low and there are very few adult fish capable of participating in reproduction.

Many comments were received again this year on the impact of predation of cod by seals. The industry considers seals to be a factor limiting stock recovery. Moreover, sponsors of the sentinel fisheries on the Lower North Shore of Quebec mentioned an abundance of seals in the weeks preceding the sentinel fisheries which might have chased cod away from the region. Eleven seals were caught in gillnets on the Lower North Shore; the majority were grey seals ranging in age from less than a year to six years.

Prognosis

All of the various abundance indices we have indicate that the biomass of the 3Pn4RS cod stock is very low (the lowest of the whole time series), and that there are very few adults in the population. The only fish still relatively abundant were from the 1990 and 1991 year-classes (which correspond to individuals 3 and 4 years old). There is, however, no sign that these year-classes are particularly abundant or that they will be able to ensure rapid recovery of this stock.

Weather conditions in the Gulf of St Lawrence have been colder than normal for the past nine years. During this period, the growth and condition of cod have deteriorated, and it is hypothesized that there is a close link between the environment and the condition of cod. Over the past two or three years, condition appears to have been so poor that it may have affected the survival of adults. Natural mortality would thus have increased, which would explain the accelerated decline in the stock since 1990. At the same time, the poor condition of spawners may have affected the ability of adults to reproduce, which might partially explain the low recruitment of cod since the mid-1980s. This remains hypothetical for the moment, and is the topic of a major multidisciplinary research effort attempting to link climatic factors to cod condition and the impact on stock productivity (growth, survival and reproductive capacity).

During the summer of 1994, the condition of cod appears to have improved considerably, based on information obtained during the sentinel fisheries. Fall 1994 was a little warmer than normal, while winter 1995 was near normal, indicating a return to more normal weather conditions. If our hypotheses on the link between the environment and cod condition prove correct, and preliminary results appear to indicate this is the case, we should see a return to more normal growth, recruitment and survival conditions. If there is no commercial harvesting, the survival of the 1990 and 1991 year-classes should be good, and the stock biomass should increase; however, as long as there is no abundant recruitment (at this point there is no sign of new abundant year-classes), stock rebuilding should be slow.

Further reading

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Contact/Contacte

Alain Fréchet
Telephone: 418-775-0628
FAX: 418-775-0542
E-Mail: A_Frechet@Qc.DFO.CA

3.2 COD in the Southern Gulf of St. Lawrence

Directed cod fishing in the southern Gulf of St. Lawrence was closed in September, 1993 because stock size had been reduced by high fishing mortality, low growth rates and reduced recruitment. New analysis indicates that overfishing and discarding of undersized fish in the late 1980s and early 1990s depleted above average year-classes that could have supported a commercial fishery in 1993-94. The results of the 1994 research vessel survey and data from other sources indicate that the adult biomass has stabilized since the closure but that the abundance of young fish is well below average. Continued low levels of fishing, similar to that in 1994, and improved recruitment are required for stock recovery.

Introduction

This assessment presents new information from the 1994 by-catch fishery and research vessel surveys conducted in July and September 1994 and January 1995. The research vessel abundance index was modified by including additional data collected outside the standard design.

Description of fisheries

The total reported landings of southern Gulf cod was 1288 t in 1994. This was the lowest landing on record, second only to the 5183 t reported in 1993 (Figure 3.2.1), 89% of the reported landings were from 4T and the remainder was from 4Vn (N-A). Landings decreased for otter trawls, gillnets, longlines and hand lines in 1994. There was a slight increase in landings by seines with the bulk coming from an experimental fishery testing the impact of lastridge rope adjustments on gear selectivity. An estimated 120 t were landed by the recreational fishery.

Directed fishing for cod in the southern Gulf was closed in 1994 and DFO imposed by-catch limits of 10% (by weight) on fisheries directed towards other species such as redfish, plaice and white hake. In 4Vn, redfish fisheries were restricted to using midwater trawls as a way of reducing cod by-catch and flatfish fisheries were not permitted in 4Vn January-April.

Fisheries in 4T directed at species other than cod were closed on 11 occasions in 1994 due to high by-catches of cod. The closures affected both fixed and mobile gear fleets fishing for flatfish and hake. There was one closure due to high incidence of small American plaice. There were no closures in 4Vn.

The views from industry on the status of the cod stock were sought at a number of meetings during 1994. In the western area (Gaspé, northeast N.B. and Magdalen Islands) the almost unanimous view was that cod abundance in 1994 was very low. In the eastern area (P.E.I. and Gulf Nova Scotia), where fishers made good catches of cod while directing for other species (lobster, hake) close to shore, the view was that cod abundance was sufficient to allow a fishery. Generally, all agreed however that cod abundance in recent years was lower than in the mid-1980s.

	1970-79	1980-89	1990	1991	1992	1993	1994
Landings[1]	50	61	58	49	41	5	1.2
TAC[2]	40[3]	58	53	48	43	12	

1. Landings for 4TVn (N-A) and 4Vs (J-A)

2. TACs for 4TVn (J-A)

3. TACs set from 1974-79

Target

The catch of southern Gulf cod is to be reduced to the lowest possible level.

Fishery data

The total number of fish landed was estimated to be 0.9 million in 1994, the lowest on record. This is down from 4.3 million in 1993 and 39.1 million in 1992. The 1994 landings were dominated by ages 6-8 (1986-88 year-classes). The mean weights at ages 7-12 increased again in 1994 while weights at other ages were comparable with the previous 5 years. However, the same trend was not seen in the research survey. The increases in the commercial weights at age may be because of the higher proportion of the landings from fixed gear which tend to land larger fish than the mobile gears. Increased mesh sizes were also in use in the mobile gear fisheries.

The total nominal cod directed fishing effort by mobile gear vessels was 52 days in 1994, distributed among otter trawls (8.5 days) midwater trawls (0.5 day), and seines (43 days). This is a substantial decrease from the 600 days reported in 1993 and the 6,000 to 8,000 days reported in 1989-92 (Figure 3.2.2).

A comparison of the sizes of fish measured by observers at sea with those sampled at port suggest that discarding may have occurred in some fleets and areas in 1994. The observer and port samples from OTBs fishing in 4Vn during the winter and from seines fishing in the fourth quarter were very similar, suggesting very little if any discarding occurred. However, at-sea samples of seines fishing in 4Tfg in the second quarter indicated more smaller fish were being caught than were being landed by unobserved vessels. The same pattern was noted in 1993. Sampling in other areas, periods and gears was insufficient to draw any conclusions.

There was insufficient fishing in 1994 to extend the commercial catch per unit effort abundance index.

Research data

The fall groundfish survey abundance index was revised this year to make better use of available observations and to take into account recent analyses of comparative fishing experiments among the three vessels that have been used. The following modifications were made:

- the 10-13 fixed stations fished from 1971-1988 are included in the index.
- all stations fished in the 1984-1987 period are included, not just the 61 stations fished in all years.
- catches by the *Lady Hammond* in 1985 are included (after adjustment to the *Alfred Needler* and, in the case of

comparative fishing sets, averaging with the paired *E.E. Prince* sets).

- paired day-night catches in 1988 were averaged and then included in the index (previously, only the day catches were used).

- all other repeat sets at the same location were averaged and included in the index.

- catches by the *E.E. Prince* and the *Lady Hammond* were adjusted to be equivalent to catches by the *Alfred Needler*.

The stratified mean number of cod per tow (ages 0+) in the 1994 survey remained at the low level observed since 1992 (Figure 3.2.3). The 1994 mean decreased by about 15% from the 1993 mean. This catch rate is comparable to the 1992 level and is the lowest since 1975. The 1989 and 1990 year-classes (ages 5 and 6) were the most abundant in the survey. The catch rate of age-2 cod continues to be low, suggesting below average year-class sizes since 1988. The estimate of total cod biomass declined slightly from 1993. Only estimates for 1975 and 1992 are lower in the 24-yr time series. The percent of the biomass in eastern 4T was 35% in 1994, the highest value in the time series. In the last three years, there appears to have been a southeasterly shift in distribution of commercial sized cod (Figure 3.2.4). Catches declined in the area between Miscou and Gaspé. There was an increase in catches between the Magdelan Islands and Cape Breton. There also appeared to be shifts depth distribution of southern Gulf cod that are related to abundance.

A juvenile survey has been conducted in Miramichi Bay/Shediac Valley in July-August since 1990. All of the year-classes occurring after 1987 (age 3 in 1990) have been weaker than the 1987 year-class. The estimates for the 1992 year-class continued to be very low. Similar to the September survey, there appeared to be many more adult fish (age 5 and older) in the shallow water covered by this survey compared to previous years. This is interpreted as a change in distribution.

A groundfish-herring survey was conducted in Cabot Strait from January 10-29, 1995. A similar, but smaller, survey was conducted in January 1994. The main objective of this survey was to determine the distribution and relative abundance of groundfish species and herring in the Cabot Strait area during the winter. A contour map of the cod catches in kg per tow (Figure 3.2.5) shows that the largest catches were made on the slope of the Laurentian Channel in 4Vn at depths of 200 to 300 m. A large catch of 2738 kg was made south of St. Paul's Island. Concentrations were also detected in 3Pn. There appeared to be lower concentration of cod in the middle of the Channel than on both sides. This is consistent with previous observations of the occurrence of the two stocks found in the area in winter. The distribution of catches was relatively similar to that observed in 1994 both in terms of area and depth. Because of the potential mixing of several stocks in winter in this area, abundance estimates from this survey should not be considered as an index for the southern Gulf of St. Lawrence cod stock until the extent of the mixing is better understood.

Seasonal cod condition has been monitored since September 1991 in the southern Gulf of

St. Lawrence. The cycle of cod condition is regular, cod attain their highest condition in the fall, usually in October-November. Condition then declines and reaches a minimum during the spawning season in May-June. Condition indices in the fall of 1994 were the highest seen since 1991.

Because the Sentinel Fisheries program was delayed, only six trips were attempted between 6 October and 15 November. Trips were restricted to the Bay of Chaleur and Shediac Valley. The results indicated that the autumn migration from the western Gulf began during mid-October 1994 and was over before the end of October. The smaller fish appeared to leave slightly after the adults. Because there was no eastern component of the program, we do not know how long it took for the cod to travel to the eastern Gulf.

Estimation of assessment parameters

Estimates of total mortality and trends in relative year-class strength were obtained from multiplicative analyses of research vessel data. A series of analyses spanning successive 5-year periods were conducted to obtain estimates of the average total mortality of cod. According to the surveys, total mortality varied between 0.45 and 0.80 in the early-1970s to mid-1980s. There was a sharp increase in the late 1980s to levels greater than 1.0. The final estimate, which was for the 1990-1994 period, indicated a decline. This trend corresponds well with the trend in cod directed fishing effort and most likely reflects variations in mortality due to fishing.

Analyses were also conducted on 2 different age groups, 2-3 and 4-6, to obtain estimates of relative year-class strength. All years were included in each analysis and the results indicate the average abundance of the year-classes during that period of their lives. There was a high degree of agreement between the two series overall except for the 1985-87 year-classes. The age 2-3 estimates indicated that these year-classes were above average in abundance but the age 4-6 analysis indicated that they were below average in abundance. The difference between the two suggests that these year-classes experienced a higher than average mortality in the pre-recruit period of their lives. The most likely cause of the high mortality on the 1985-87 year-classes is increased exploitation in the late 1980's and early 1990's. The period of high mortality corresponds to the years with the highest fishing effort, 1989-92 (Figure 3.2.2).

Three methods of sequential population analysis (SPA) were used in this assessment: ADAPT, Laurec-Shepherd (LS), and Extended Survivors (XSA). ADAPT was calibrated with two indices of abundance, the otter trawl CPUE at age (up to 1993) and research survey mean catch per tow at age. In previous assessments, it was apparent that the efficiency of the otter trawl fleet was increasing through time. In addition, it was noted that the fraction of the population sampled by the research survey may increase as the population size increases. The ADAPT formulation allowed for these relationships. Both the LS and XSA calibrations used only research survey results for calibration and no adjustment for changes in catchability with stock size were used.

Assessment results

All three SPA analyses provide a similar view of the state of the stock. Total and spawning biomasses were low in the mid-1970s (Figure 3.2.6) then rapidly increased until the mid-eighties and declined since. With the closure of the fishery in 1993, the decline in abundance has stopped but biomass is close to the lowest level observed. Fishing mortality averaged approximately 0.6 up to 1988 (Figure 3.2.7) but then increased to around 1.0 in 1992. Fishing effort was reduced markedly in 1993 with the closure of the fishery. The catch of slightly above 5,000 t in 1993 resulted in a fishing mortality near the $F_{0.1}$ = 0.2 reference level. The further decrease in effort in 1994 resulted in a decline in F. Fishing mortality is estimated at between 0.02 to 0.05 depending on the analysis.

The research survey results indicate that the 1985-87 year-classes were above average in abundance during the juvenile period (ages 2-3) while the SPA results indicate that recruitment declined throughout the 1980's (Figure 3.2.8). A probable reason for this discrepancy is that a substantial number of the 1985-87 year-classes were caught and discarded before they reached commercial size. This would have occurred during the period 1989-92 when fishing effort and adult fishing mortality peaked. Unfortunately, estimates of these discards are insufficient to be included in the SPA. Both the SPA and research survey indicate that recruitment has been poor in the late 1980s and early 1990s. There is no indication of improvement.

Ecological considerations

Evidence for competition between cod and American plaice is discussed in Section 5. Reduced growth rates of cod in the 1980s has meant that year-classes had to be more abundant in order to replace the spawning biomass that produced them in the first place. This did not occur, it appears that incoming year-classes were heavily exploited in recent years, and since 1988 they have been below average in abundance. The result is decreased stock biomass. While yield per recruit analysis would suggest that slower growing year-classes should be fished harder than fast growing ones, consideration of replacing spawning biomass would suggest the opposite. When choosing future fishing mortality targets, consideration should be given to replacing spawning biomass.

Future prospects

Catch projections were conducted with the population estimates from the ADAPT, LS, and XSA calibrations. The 1992 year-class age 3 abundance at the beginning of 1995 was set at 20 million based on a prediction from the research survey. There is currently no information available on the abundance of the 1993 year-class; however, its abundance was set at 20 million at age 3 since all recent year-classes have been in this range. This year-classes will contribute very little to catch projections to 1996. Weights at age were the average from 1992 to 1994. Partial recruitment was derived from fishing mortalities in the period 1992 to 1994 from the ADAPT analysis with full recruitment at age

9. In the absence of a TAC, but given that catches of cod in 1995 will likely occur as by-catch in other fisheries and in the recreational fisheries, it was assumed that catches in 1995 would be similar to 1994 (1,300 t).

A 1995 catch of 1,300 t would correspond to a fishing mortality of 0.017-0.025, depending on the SPA calibration used, and spawning biomass would increase. The estimated $F_{0.1}$ catches in 1996 were between 11,000 t and 16,000 t, but this would result in a decline in spawning biomass between 1996 and 1997 of from 5% to 9%. The spawning biomass would remain stable for catches between 6,000 t and 8,000 t. If there was no catch in 1996, the projected increase in spawning biomass was between 6% to 10%.

Prospects for a firm and steady stock recovery continue to be bleak. Biomass and stock abundance are currently very low, close to the lowest previously observed for this stock. Recruitment has been poor in recent years; the 1988-92 year-classes are all estimated to be well below average in abundance. Growth continues to be below average. Although the closure of the fishery in 1993 has halted the precipitous decline which started in the mid-1980's and there are signs of increased adult biomass, fishing mortality must remain well below $F_{0.1}$ for this to continue.

Management considerations

The current management system did not prevent the high level of fishing that was exerted on this stock in the 1989-92 period and the ensuing stock crash. Only one quarter of the historical fishing effort will be required to harvest the resource if it does recover. In the initial years of the recovery fishing should occur well below this level. Reopening the fishery to the same fishing fleet and using the same management approach as before will likely result in immediate overfishing of the stock.

For more information:

Research Documents: Sinclair, A., G. Chouinard, D. Swain, G. Nielsen, J.M. Hanson, L. Currie, T. Hurlbut, R. Hébert. 1995. Assessment of the southern Gulf of St. Lawrence cod stock, March 1995. DFO Atl. Fish. Res. Doc. 95/39.

Shelton, P. and A. Sinclair, 1995. Analysis of past replacement levels in the southern Gulf cod stock. DFO. Atl. Fish. Sci. Res. Doc. 95/40.

Contact/Contacte:

Alan Sinclair
Tel: 506-851-2721
Fax: 506-851-2387
E-Mail:Sinclair@GFC.DFO.ca

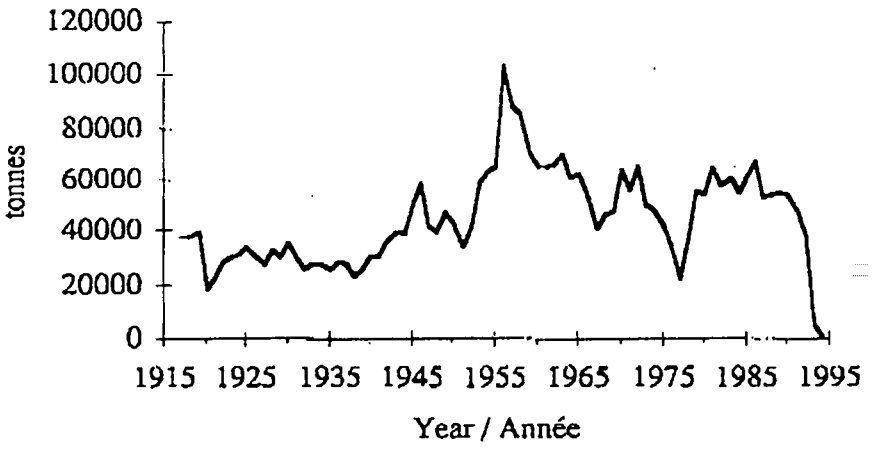


Figure 3.2.1 Landings of southern Gulf cod, 1917-94.
Débarquements de morue du sud du golfe, 1917-94.

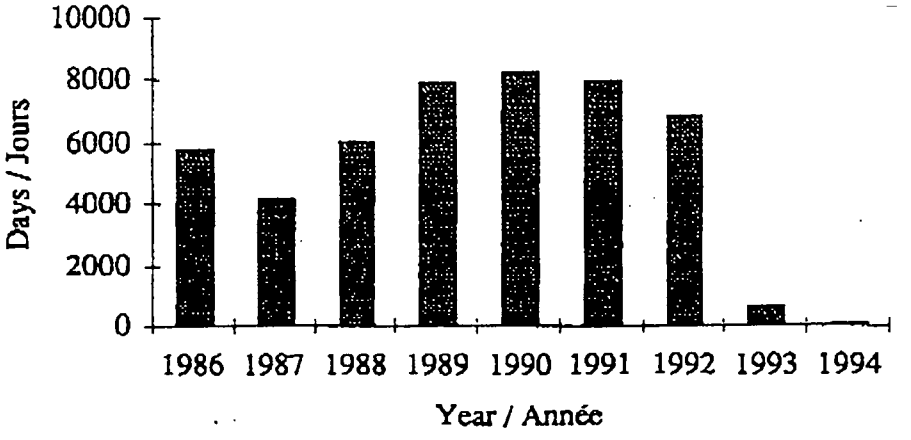


Figure 3.2.2 Cod directed fishing days by mobile gear vessels.
Jours de pêche dirigés vers la morue par les engins mobile.

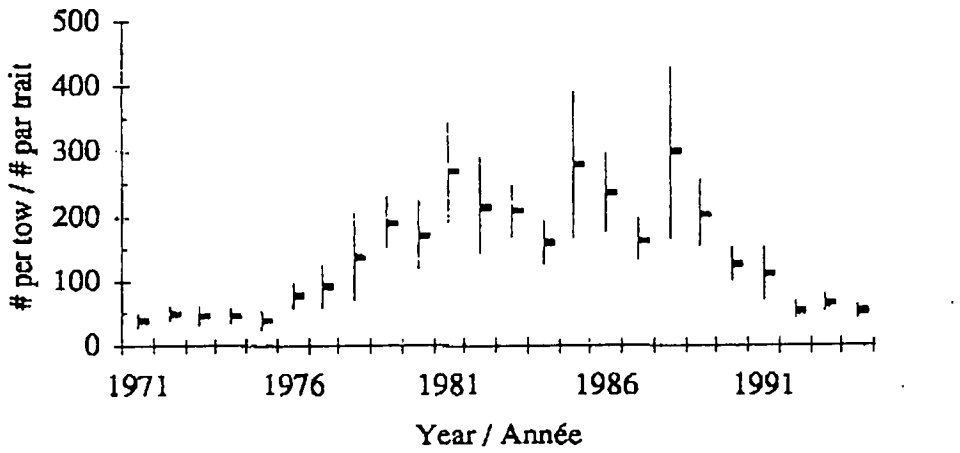


Figure 3.2.3 Mean numbers per tow (ages 0+) from the September groundfish surveys.
Nombre moyen par trait (âges 0+) lors du relevé du poissons de fond de septembre.

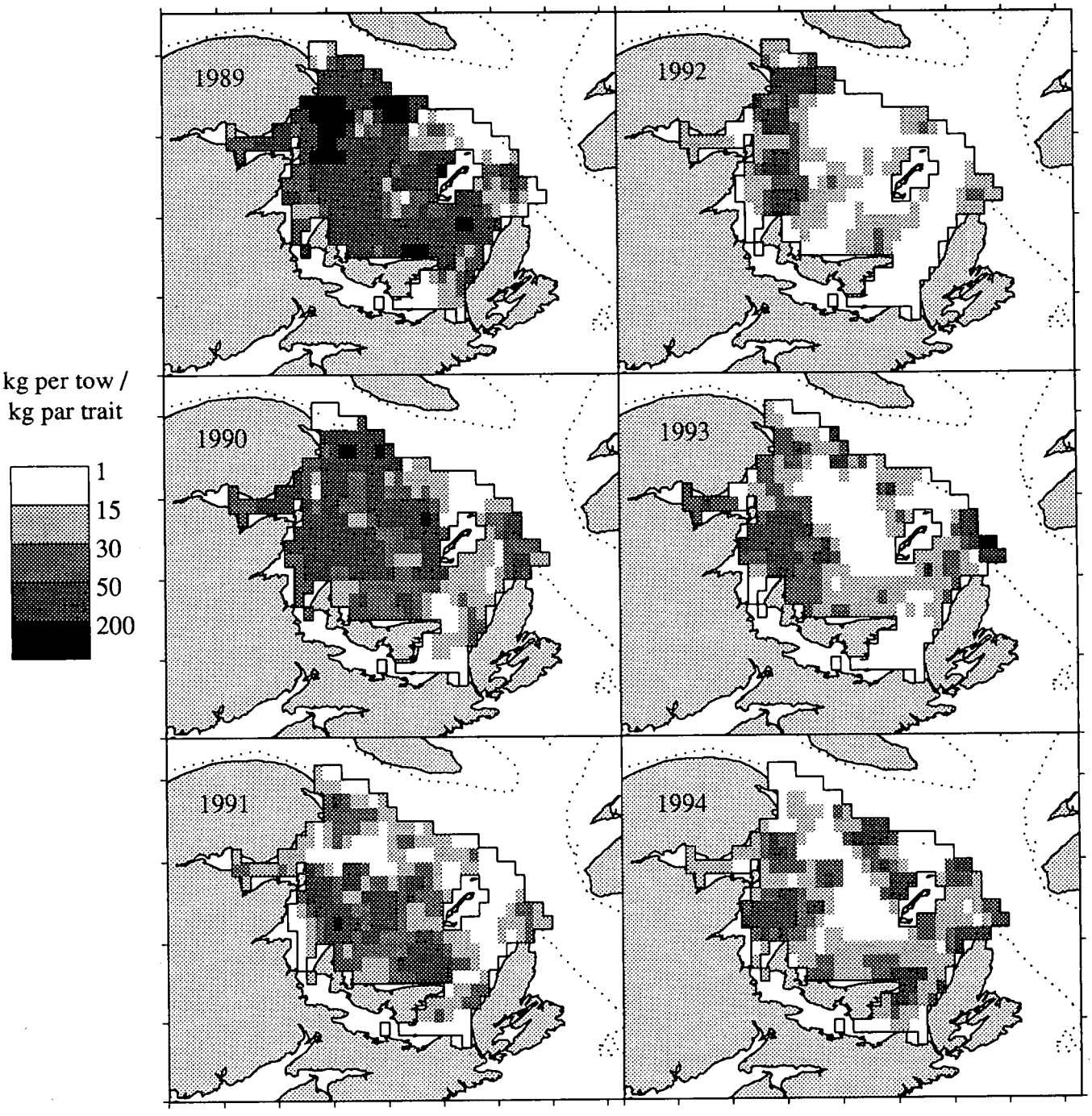


Figure 3.2.4 Distribution of research vessel catches of commercial sized cod (>41cm).
Prises de la morue de taille commercialle (>41 cm) lors des relevés de recherche.

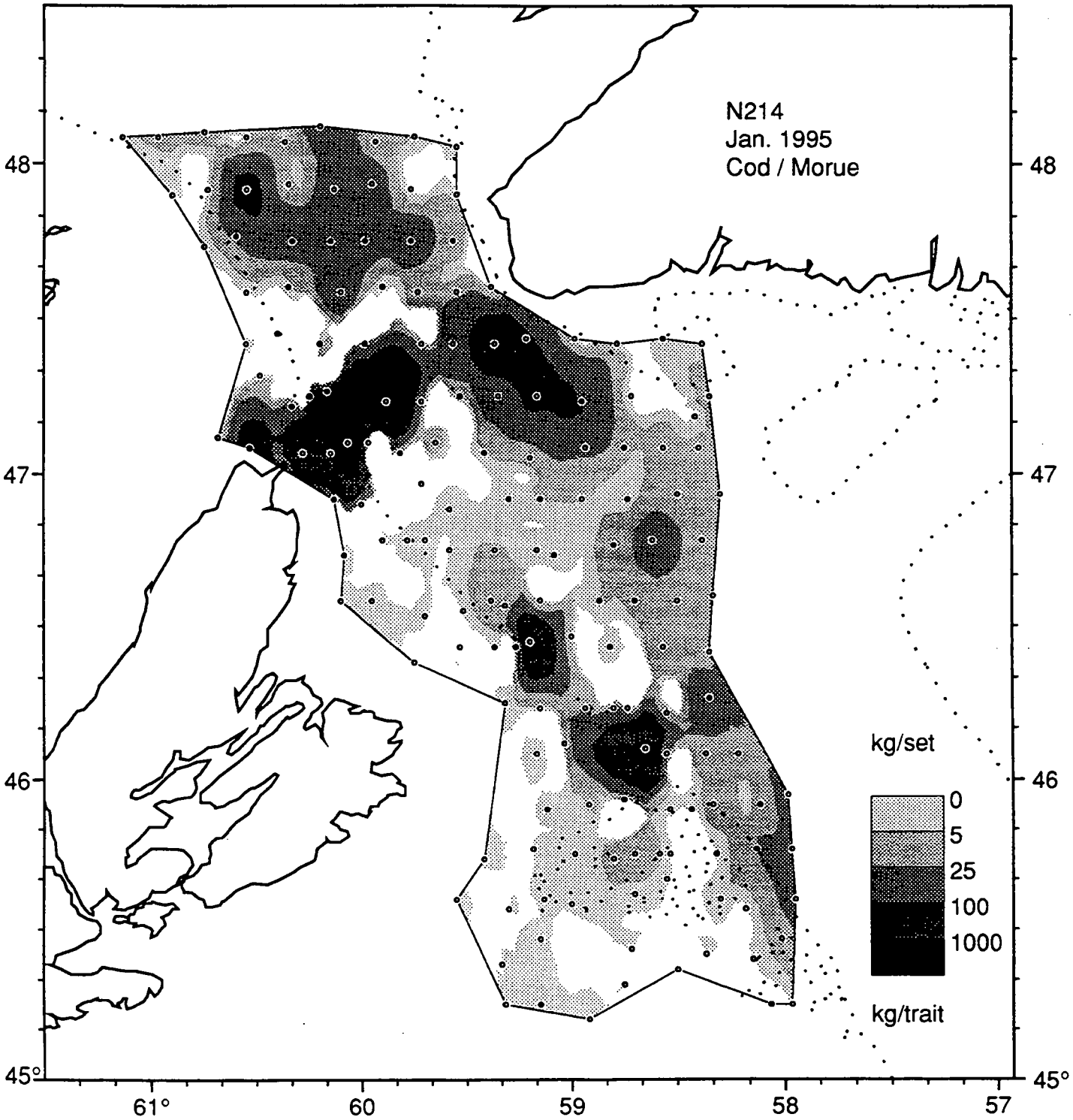


Figure 3.2.5 Catches of cod (kg/tow) during the January 1995 groundfish and herring survey in Cabot Strait. Open circles indicate set locations, dotted line is the 200 m isobath. Prises de morue par le relevé du poissons de fond et du hareng dans le détroit du Cabot, janvier 1995. Les lieux de pêche sont indiqués par les cercles et la ligne pointillée indique l'isobathe de 200 m.

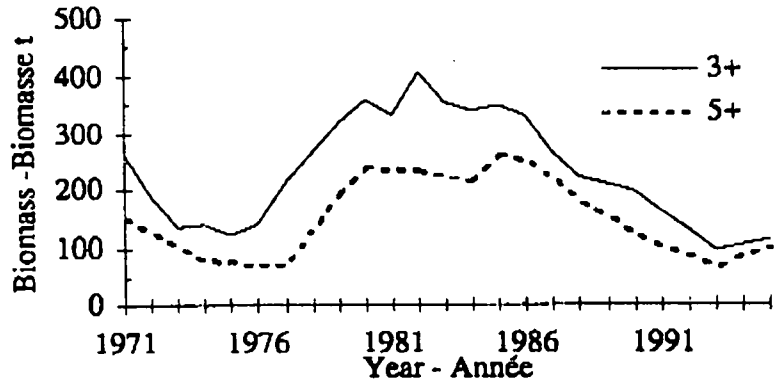


Figure 3.2.6 Total (3+) and adult (5+) biomass ('000 t) for southern Gulf cod 1971-94.
Biomasse ('000 t) totale (3+) et adulte (5+) de la morue du sud du golfe.

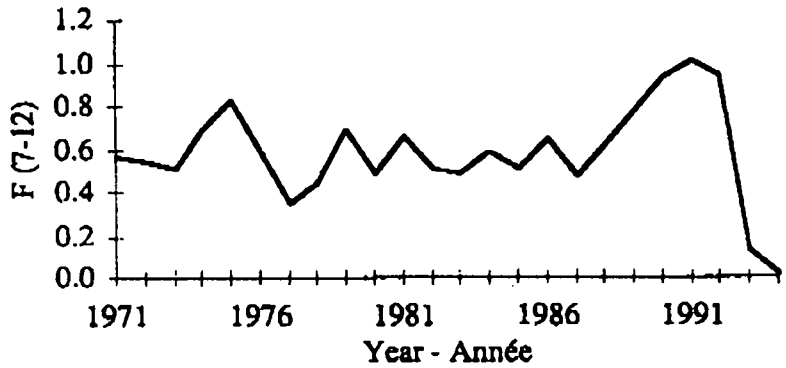


Figure 3.2.7 Fishing mortality rate (F).
Taux de mortalité due à la pêche (F).

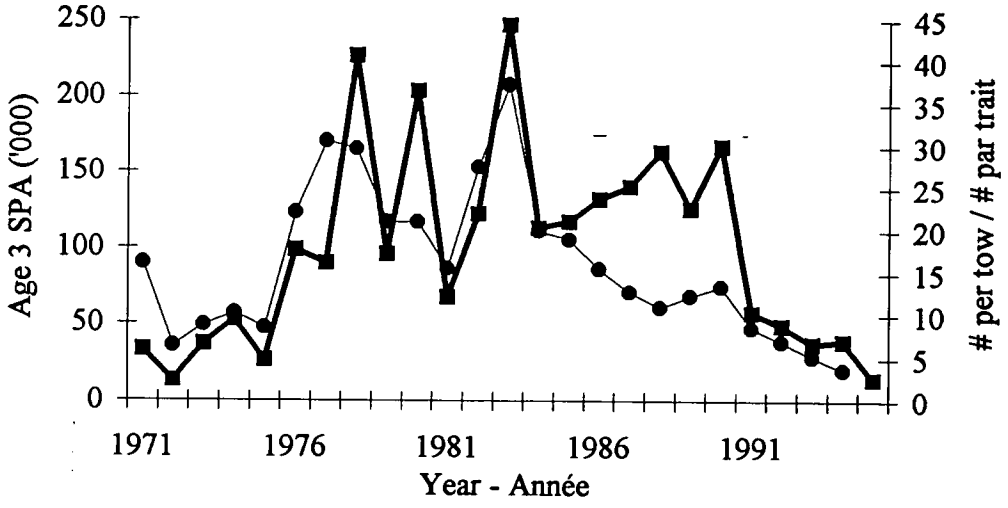


Figure 3.2.8 SPA (circles) and research survey (boxes) estimates of age 3 recruitment. Estimés de recrutement (âge 3) du ASP (cercles) et relevés de recherche (boîtes).

3.3 REDFISH
Gulf of Saint-Lawrence (Unit 1: 4R, 4S, and 4T plus 3Pn4Vn [Jan.-May])

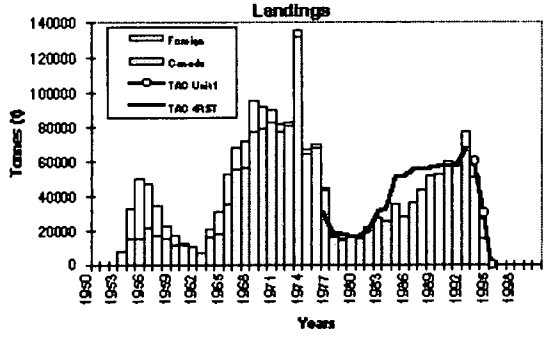
Note: This interim report is an update of report 94/4 with the results of the groundfish survey conducted in August 1994 and with the recommandations of a workshop held in Halifax on June 1 and 2 1995. A new SSR on redfish will be published in late September 1995 following the completion of the groundfish survey of 1995.

Introduction

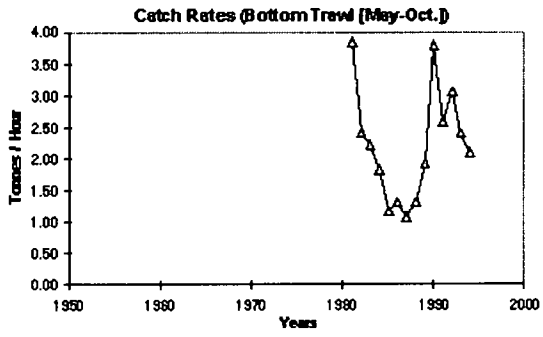
Stock levels are declining and the exploitation rate (% of fish removed by fishing) is high for a slow-growing species like redfish. The fishery in 1993 was dominated by fish born around 1980 and in the early 1970s. The fish in these two groups are primarily members of the species *Sebastes mentella.* Recruitment has been low since 1980. Two recent year-classes have been thought to show promise but, the numbers in the 1985 and 1988 year-classes have declined rapidly since 1991; they are identified as *S. fasciatus*, a species whose biology is not well known.

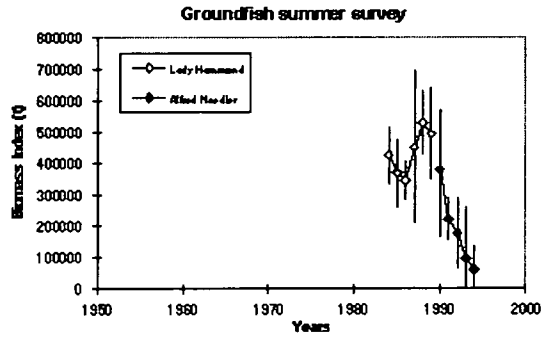
The TAC for new management Unit 1 was 60,000 t in 1993 but was reduced as a preventive measure to 30,000 t in 1994. Following FRCC consultations in the fall of 1994, the Minister announced in December 1994 the total closure of the fishery for 1995.

Analysis



Landings of these stocks have averaged 46,000 t. In the past 4 years, they have exceeded 60,000 t, except in 1993, when they declined to 51,000 t following the introduction of new management areas (units 1, 2 and 3). The Fisheries Oceanography Committee has concluded that the November and December catches in subdivisions 3Pn and 4Vn consisted primarily of redfish from Unit 1, and that the management unit should therefore be modified. Including the November and December catches in subdivisions 3Pn and 4Vn, however, the 1993 total for Unit 1 would be 57,000 t. In previous years, catches of redfish in these two subdivisions have generally been less than 1000 t in these two months. Catches by bottom trawlers fishing

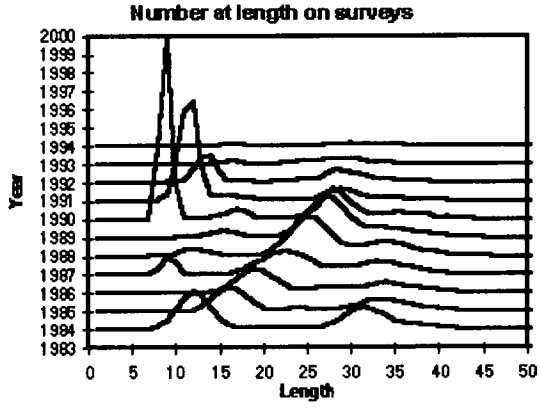




between May and October have been affected less by technological change than those involving mid-water trawls and are believed to be a better reflection of changes in redfish abundance. The CPUE (tonnes/hour) show two large peaks (in 1981 and 1990) and have declined by 34% since 1990. Daily catch rates, which include time spent by vessels looking for fish, show a similar tendency (decline of 34% between 1990 and 1993). The nominal effort rose from 4600 days in 1990 to 5600 days in 1993, but this last figure does not include the major effort in subdivisions 3Pn and 4Vn in November and December 1993. Given the species' gregarious nature and the exchange of information between the boats of the same company, these catch rates probably overestimate stock levels. When stocks decline, fleets can maintain their CPUE by locating dense aggregations even as they decrease in number and size. For these reasons, CPUEs are not considered a sufficiently quantitative index of stock levels to use in mathematical models.

Two groundfish surveys (summer and winter) are undertaken to obtain abundance indices for the resource. The estimates have declined by nearly 50% in the two most recent surveys. The summer survey is also used to estimate the abundance of year-classes of fish and to monitor their decline over time. Estimated mortality rates are relatively high (total mortality of 0.44, implying a fishing mortality of 0.34, well above the generally accepted reference level $F_{0.1}$ for redfish of 0.15.

Similar calculations have been performed on the commercial catch per unit effort data. While these are more difficult to interpret because of the biases inherent in CPUE data, they also indicate that mortality attributable to fishing was relatively high in 1992-1993= (0.18).



One large year-class (1988) was identified in the 1990 survey, but its numbers have declined sharply since that time. By 1993, it had virtually disappeared, and is unlikely to contribute significantly to the fishery in the future. The reason for its disappearance is unclear; it may be due to emigration (into Unit 2), mortality, or non-availability to bottom trawling because of a pelagic distribution. The latter explanation can be readily verified by examining the catches of mid-water trawlers once these fish are of adequate size (1995).

Redfish are highly concentrated in the Cabot Strait area; over the past three years, this concentration has moved into Subdivision 3Pn and even spilled over into 3Ps. In 1993, fishing began in 3Pn in October, very early compared to previous years, suggesting that the redfish may have moved out of the Gulf early. Fishing of these concentrations of Gulf redfish intensifies the exploitation rate for Gulf redfish.

Assessment

Heavy fishing pressure and low recruitment levels over the past 4 years explain the reduction in abundance observed by the summer research survey since 1991. Stock levels will continue to decline until one or more sizable year-classes become available to the commercial fishery. No such sizable year-classes currently exist, and the one on which our hopes were based (1988) does not appear to be present any longer. It is impossible to predict when a sizable new year-classes will appear but, even when it does, it will not be recruited to the fishery until seven or eight years later. The exploitation rate was approximately 28% (F=0.34), very high for a slow-growing species like the redfish. In addition, fishing appears to have expanded in 1993. The reduction of the TAC to 30,000 t in 1994 will have permitted a reduction in the exploitation rate. However, this catch level is probably not sustainable over the medium term, given the existing biomass (probably less than 200,000 t) and the absence of any significant recruitment.

Update from September 1994.

The results from the groundfish survey completed in September 1994 do not give any indications of change in the status of the redfish stock. The biomass index has decreased again slightly (by approximately 15 %), as expected. The distribution of fish was somewhat different from past years, most of the fish being found in the South-East part of the Gulf, near Cabot Strait. There is no indications of small fish (<12 cm) being present in abundance, indicating that there will be no strong recruitment this year again.

Future perspectives

An Industry-DFO sciences workshop was held on June 1 and 2 1995 to discuss the major scientific issues relevant to the management of redfish stocks on the Atlantic coast of Canada. The following problems are those that have identified by the workshop participants as requiring a concerted research effort in the next years.

- **Conservation measures**, especially with regards to the protection of small fish,

the management strategies, and co-management and co-research.

- **Improved indicator of stock status**, including research surveys, index and sentinel fisheries, stock assessment techniques, and monitoring of technicological changes in the fishery.

- **Distribution and stock identification**, especially with regards to the species issue, the stock identification (*i.e.* boundaries), and the role of ocean climate on distribution.

- **Recruitment**, including factors that affect the survival of larvae and juveniles, and the disappearance of year classes (especially that of 1988).

A multidisciplinary programme to address these issues on the Atlantic Coast will be put together jointly by Industry and DFO representatives. The programme should be in operation by the end of the summer 1995 and will be realised jointly by DFO and Industry.

Contact/Contacte

B. Morin
Telephone. 418-775-0695
FAX: 418-775-0542
E-Mail: B_Morin@QC.DFO.CA

3.4 Southern Gulf Plaice

American plaice in 4T were exploited mainly by longlines in the 1930s. The fishery became predominantly an otter trawl - seine fishery from the late 1940s to 1960s and diversified somewhat thereafter. Once considered a bycatch of the cod-directed fishery, plaice have increasingly become a directed fishery. Landings have declined sharply from the mid 1980s when close to 10,000 t were reported. The discarding at sea of commercially undersized plaice has been significant in this fishery and persists in spite of management measures taken over the past two years. Research surveys indicate that abundance and biomass are currently at their lowest levels over the past 24 years. Recruitment was strong in the early 1970s but has been weak with the exception of moderate increases in the abundance of the 1986 and 1987 year-classes.

Introduction

American plaice is an important groundfish resource in the southern Gulf of St. Lawrence, exploited by a diverse fishery of mobile and fixed gear. Plaice is the most abundant groundfish species in research surveys of the southern Gulf, second only to Atlantic cod in biomass. The stock status of 4T American plaice has been reviewed annually since 1976.

Description of fisheries

Plaice landings in 4T totalled 2420 t in 1994, a slight increase from their level in 1993, but near the lowest on record since 1965 (Figure 3.4.1). Annual landings for this stock have averaged 7840 t since 1965. Most of the plaice landings in 1994 originated from eastern 4T in unit areas 4Tf and 4Tg, where landings were about twice the level recorded in 1993. Seines were the most active gear, contributing 1699 t of landed plaice. The fishing season was delayed in 1994 by the late migration of cod into the Gulf and an abundance of juvenile cod inshore; however, fewer closures of the plaice fishery occurred in 1994 than in 1993.

During consultations with industry, fishers indicated that catches were strong in eastern 4T, but weak in western 4T. This view was supported by landing statistics and by maps of plaice during the annual 4T groundfish survey in 1994. Most of the five participants targetting for plaice in the Index Fisher Program felt that plaice abundance in 1994 was equal or better than abundance in 1993 or the previous five years (1989-1993). Although this view concurs with research survey data, most participants in the program felt that plaice abundance in 1994 was equal or somewhat better than in their longterm experience, ranging from 11-36 years.

	1970-79	1980-89	1990	1991	1992	1993	1994
Landings	9029	7603	4907	5222	5198	1857	2420
TAC	10000	10000	10000	10000	10000	10000	10000

Target

The target for American plaice is a fishing mortality corresponding to $F_{0.1}$. Because of discarding, it has been difficult to estimate the

levels of fishing mortality corresponding to that value.

Fishery data

Port samples of commercial plaice catches were obtained from mobile gear in 1994. Over 6000 plaice were measured and otoliths were taken from over 800 plaice. Locally used catches of 4T plaice, estimated by fishery officers, were 70 t in 1994, or 3% of the annual plaice landings. In 1993, locally used catches of plaice contributed 24% of the total.

The number of plaice landed in 1994, estimated from combined landings at age of males, females and juveniles, was more than twice the estimate for 1993, but was lower than landings from 1976-1992. Discarding was detected by comparing length-frequency data from onboard fishery observers and port samplers. The discarding of commercially undersized plaice remains a significant problem in this fishery, preventing a reliable index of commercial catch rates. The nominal fishing effort (number of days fishing) by seines and trawls directing for American plaice increased in 1994. Ninety-two percent of plaice landings were from the directed fishery.

Research data

The main source of research data is the groundfish survey of the southern Gulf, conducted every September since 1971. Plaice in the September groundfish survey attained maximum abundance in 1977 at an average of 1127 plaice per tow (Figure 3.4.2). Abundance declined in the late 1970s and since 1982 it has fluctuated at a low level. The mean number of plaice per tow was 209 in 1994, almost identical to the estimate for 1993. The catch at age of plaice in research data indicated a decline in abundance of each age class over most of the past 24 years. The biomass estimates of 4T plaice have tended to follow the abundance pattern indicated by the mean numbers per tow. However, the biomass of 4T plaice in 1994, estimated at about 56000 tons, was the lowest since 1971, slightly lower than biomass estimated in 1993. It is important to note that the catchability of the sampling gear for plaice has not been determined; biomass estimates are therefore minimal and should be considered as an index of stock biomass.

The September groundfish surveys provide useful descriptions of the distribution of plaice in the southern Gulf. Plaice tend to be broadly distributed in 4T, with concentrations off the Gaspé coast, in Chaleur Bay, the Shediac Valley, and off the coast of Cape Breton. Plaice have tended to maintain the same areas of concentration during periods of high and low stock abundance. In 1994, plaice abundance was exceptionally low in western areas of 4T and stronger in the east, a pattern that was also noted by fishers. Seasonal surveys, conducted over several months during the 1980s, indicate that plaice overwinter in the Laurentian Channel and off Cape Breton. Research surveys of Cabot Strait during January 1994 and 1995 indicated that a significant portion of the stock concentrates in 4Vn during winter.

Estimation of stock parameters

Estimates of total mortality (Z) and recruitment were based on analyses of research survey data. Total mortality over ages 5-13 years was estimated separately for male and female plaice. Males had higher total mortality than females for the period 1971 to 1987. Since 1988, mortalities on male and female plaice have converged and in some years female plaice have experienced slightly higher mortality than males. Total mortality peaked in the mid-1970s, declined to 1985 and increased to the present.

Mean catch per unit effort in research data, standardized by year-class, indicated that recruitment was strong for year-classes originating in 1970-1974. Year-class strength declined and has been relatively stable since the mid 1970s, with a moderate increase in 1986 and 1987.

An index of fishing mortality (relative F) was estimated by modelling the ratio of commercial catch at age and research catch at age. Relative F was low in the 1970s, increased through the 1980s and has declined since 1992.

Assessment results

Plaice are currently at low abundance and biomass in 4T. Landings of 4T plaice are near their lowest level recorded over a 30-year period. The increase in landings in 1994 over 1993 landings is largely attributable to an increase in fishing effort. Age-7 plaice were prominent in the commercial catch at age during 1994. This may indicate a strong 1987 year-class, an observation that is supported by research survey data. However, 1994 is the first year that this year-class has appeared strong and it is too early to confirm its significance to the fishery. Total mortality and fishing mortality have declined over the past two years.

Views of industry contrast strongly with the pattern observed in research data. Further work will be undertaken to expand our understanding of the perceptions of fishers on the abundance of plaice by contacting more fishers and compiling the results by region and gear sector.

Ecological considerations

There is evidence that plaice and cod compete for food in the southern Gulf, with cod as the dominant competitor. Plaice and cod overlap in their distributions. Cod <40 cm long and plaice <35 cm consume similar prey, mainly mysids and gammarid amphipods. In periods of strong cod abundance, the number and growth in size of plaice has declined.

Knowledge of the distribution of plaice size groups is necessary to develop strategies for reducing the capture of commercially undersized plaice. Mapping of the proportion of juvenile plaice in September groundfish surveys indicates that plaice <30 cm in length are widely distributed throughout the southern Gulf. This work is continuing to identify preferred areas for juvenile plaice.

Future prospects

Current methods of assessing 4T plaice do not provide forecasts of abundance. Recruitment indices, based on the September groundfish survey, suggest that recruitment has been generally poor since the mid-1970s. Recovery of the stock will depend on improved recruitment and reduced fishing mortality.

Management considerations

Management measures have come into effect over the past two years that should reduce discarding and misreporting of catches. Industry has taken positive steps to improve the fishery by adopting larger mesh sizes. It is important to maintain and improve catch statistics. In 1993, a high proportion of the 4T plaice landings (24%) were obtained from Supplementary "B" slips representing unreported catches destined for bait fisheries and personal consumption. Discarding persists in this fishery and it results in a loss of yield. Commercial catches of plaice are underestimated due to discarding, preventing an estimate of commercial catch rates and causing uncertainty in management strategies and appropriate targets.

For more information:

Research Document/Document de recherche: Morin, R., G. Chouinard, I. Forest-Gallant, R. Hébert, T. Hurlbut, G. Nielsen, A. Sinclair and D. Swain. 1995. Status of American plaice in NAFO Division 4T. DFO Atlan. Fish. Res. Doc. 95/49

Contact/Contacte:

R. Morin
Tel: 506-851-2073
Fax: 506-851-2387
E-Mail: morinR@GFC.DFO.ca

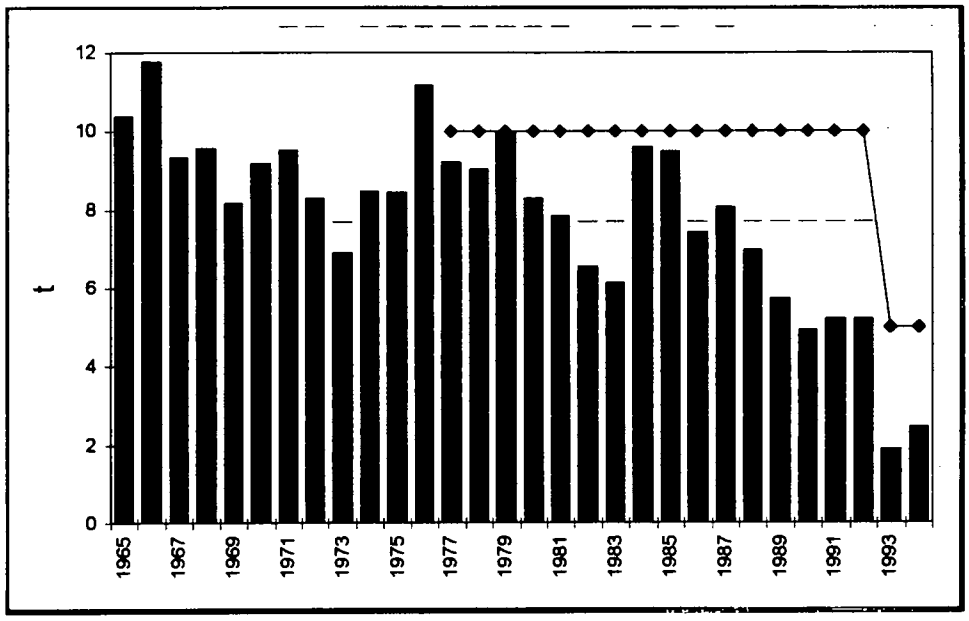


Figure 3.4.1 American plaice landings and TAC's in 1000's of tonnes.
Débarquements de plies canadiennes et TAC en milliers de tonnes.

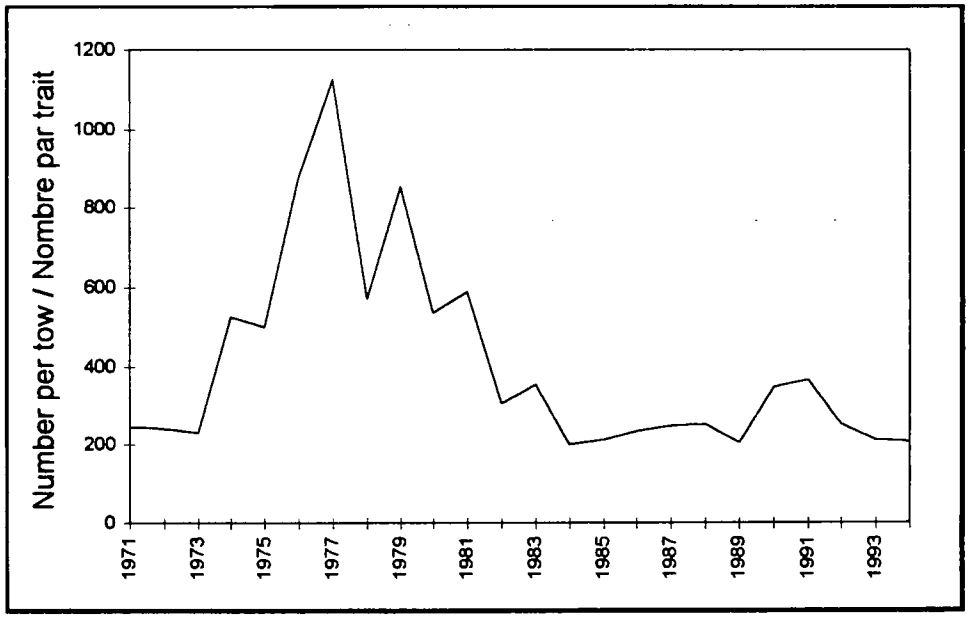
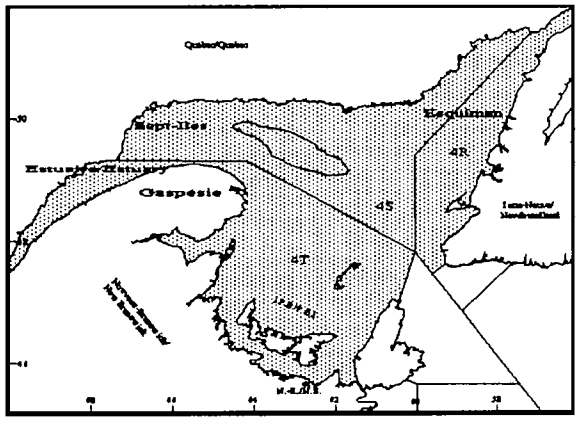


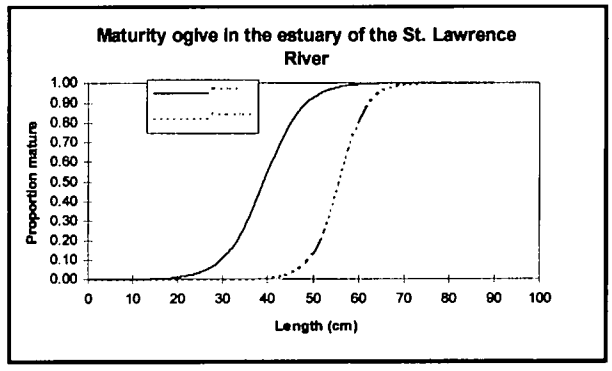
Figure 3.4.2 American plaice abundance in research surveys.
Abondance de la plie canadienne dans les relevés scientifiques.

3.5 GREENLAND HALIBUT Gulf of St. Lawrence

Introduction



Greenland halibut is a flatfish found at depths of up to 1,500 m (830 fathoms) in the North Atlantic. In the Gulf of St Lawrence, it is found at shallower depths of between 200 and 500 m (110-280 fathoms). The main concentrations of Greenland halibut during the summer are found west of Anticosti Island and, to a lesser extent, north of the island and near the west coast of Newfoundland in the Esquiman Channel. Up until recently, it was believed that exchanges between the Gulf Greenland halibut stock and outside populations were very extensive, which had an impact on the management and assessment of this stock. A study using parasites as an indicator, however, showed that the adult population appears to have been sedentary in the Gulf of St Lawrence for several years. The 4RST Greenland halibut population has therefore been managed as a separate population since 1992. Additional analyses on parasites have also shown that the degree of exchange between Greenland halibut found in the St Lawrence estuary and those of the Esquiman Channel is low. On the other hand, observations during the winter show a concentration of Greenland halibut in the Cabot Strait area, the origin of which remains to be determined. Some 1,800 fish were marked in the St Lawrence estuary in 1994 in order to better document Greenland halibut movements.



Biological information collected on Greenland halibut over the past 15 years is currently being re-analysed to determine whether any changes have taken place during the period. Based on figures from the early 1980s, the growth of males and females is basically the same up to the age of five. At this age, the males reach sexual maturity and begin to grow more slowly than females. The weight of fish in relation to their length decreased in the late 1980s but has stabilized since 1990. This deterioration in fish condition is not due to a change in the growth rate, since the same phenomenon was observed in weights in comparison to age.

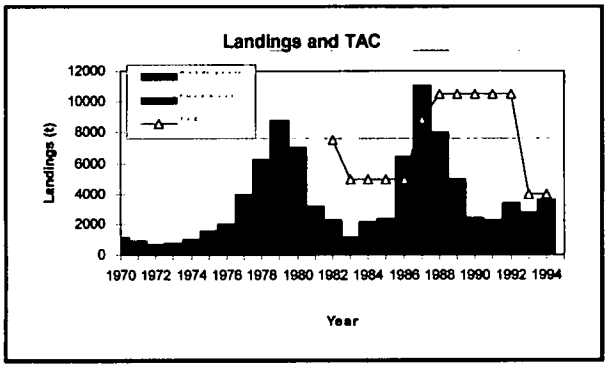
The sexual maturation of Greenland halibut does not appear to have changed in recent years. The length at which 50% of males reached sexual maturity was 39 cm while that of females was 56 cm. This species generally spawns between January and April and groups of Greenland halibut were observed spawning in the deep waters of the Laurentian Channel during winter trawl surveys.

Recruitment success has been fairly low over the past 15 years; however, two periods can be identified when more abundant year-classes were produced: 1979-80 and 1987-88. It is interesting to note that these periods correspond to two peaks in the abundance of stock, indicating a possible relation between stock abundance and recruitment.

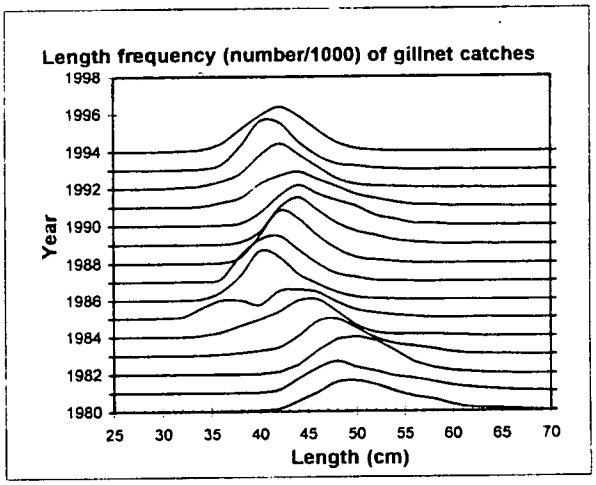
The diet of Greenland halibut varies with their size. Whereas small halibut feed mainly on small fish and crustaceans, including shrimp, larger halibut eat mostly fish, notably capelin, herring, cod and redfish.

Description of the fishery

Until the mid-1970s, Greenland halibut landings in 4RST consisted chiefly of by-catches from other fisheries. Later, a directed fishery using gillnets and bottom trawls developed. This fishery is now dominated by vessels fishing with gillnets whose home ports are in Quebec and on the west coast of Newfoundland. The data series on catches for all provinces shows two peaks: the first in 1979 (8,800 t) and the second in 1987 (11,000 t). In 1988, catches began a steep downturn, falling as low as 2,300 t in 1991,



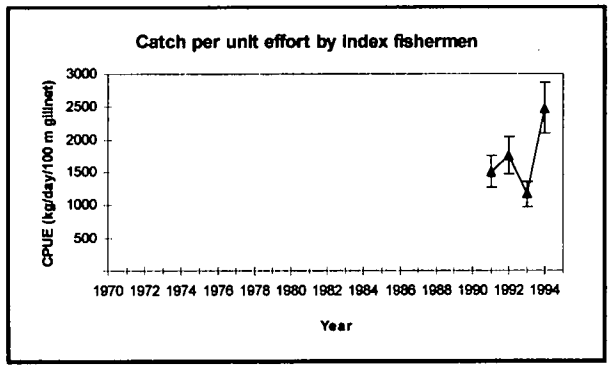
and since then they have fluctuated around 3,000 t. Landings are likely to have exceeded 5,000 t in 1994 since the summer fishing season was terminated in mid-September when the fixed-gear quota was exceeded. Catches of Greenland halibut from the shrimp fishery fell from 700 t to 10 t between 1992 and 1994, mainly due to the introduction of the Nordmore grate in this fishery. The total allowable catch (TAC) has been set at 4,000 t since 1993.



The size frequencies of fish caught in gillnets showed a significant decrease in the size of Greenland halibut caught from 1980 to 1985 following a decrease in mesh size from

165 mm (6½ inches) to 140 mm (5½ inches). In 1986, the stronger 1979-80 year-classes began to recruit to the fishery, and so the average length of fish caught rose gradually as these cohorts grew. By 1990, the cohorts had been completely harvested; the fishery then began targeting new year-classes that were recruiting to the population and the average length consequently again decreased. The fishery has depended heavily on annual recruitment since that time. In 1994, the largest proportion of Greenland halibut caught with gillnets measured 41-45 cm in 1994 and were mainly fish born in 1988 which began to recruit to the fishery in 1993. The proportion of females in catches rose from 40% in 1990 to 70% in 1993 and 1994.

Abundance indices



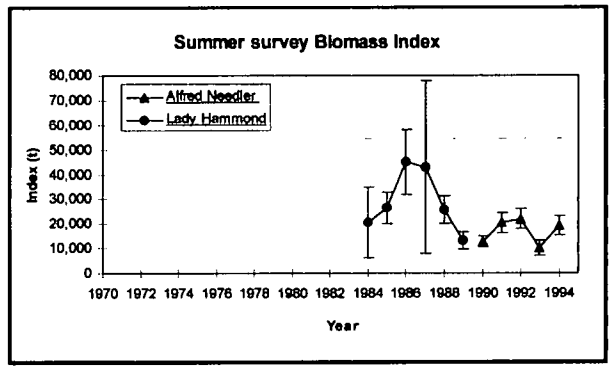
Index Fishermen Program

The Index Fishermen Program for Greenland halibut was started in 1991 to obtain first-hand information from the gillnet fleet. This program has yielded catch and effort data for Greenland halibut on the four main fishing grounds: the St Lawrence estuary, the northern Gaspé Peninsula, the Sept Îles area and the Esquiman Channel near the west coast of Newfoundland.

Catches per unit of effort (CPUE) have generally increased since 1991, except in 1993, rising from 1.5 to 2.5 kg/day/100 m of gillnet. However, catch per unit effort declined regularly throughout the fishing season. During the same period, catches by index fishermen shifted toward deeper waters at 400 m (200 fathoms).

Trawl survey

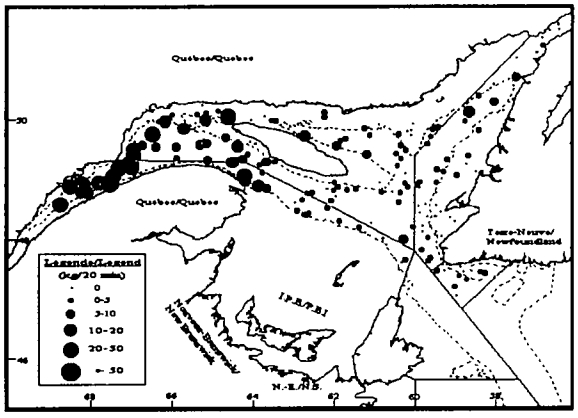
Two annual trawl surveys were carried out on groundfish in the northern Gulf of St



Lawrence. One was carried out in the summer by the Lady Hammond (1984-1989) and the Alfred Needler (1990-1994). The other was a winter survey by the Gadus Atlantica between 1978 and 1994.

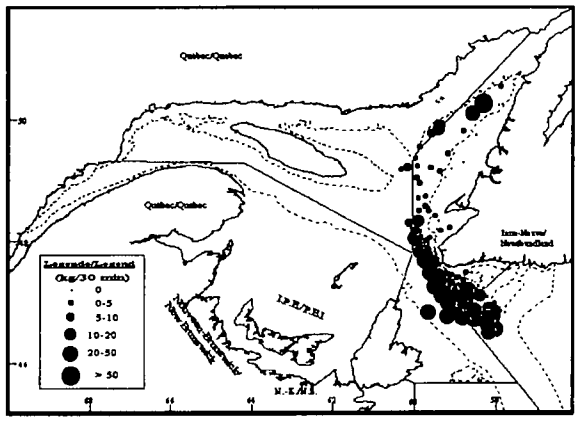
The summer survey biomass estimate has been relatively stable since 1990, except for 1993. The low 1993 figure was also seen in the CPUE of index fishermen for that year. We

cannot, however, conclude that these two events are related since the shrimp trawl used in the survey and gillnets do not target the same length groups in the population.



In 1990, a size frequency mode was observed in catches from the summer survey. This mode was made up of fish born in 1988 and has been a major factor in summer survey catches since that time. Also noteworthy was the very low abundance of fish over 50 cm during the same period and the estimated biomass of this size group, which is very low and represents 5% of the total biomass. The number of juveniles (fish under 20 cm) observed in the summer trawl survey has been below average for the past two years.

Abundance estimates derived from the winter survey have been low and relatively stable since 1989. Given the sketchy information available on the winter distribution of Greenland halibut in the northwestern Gulf, it is difficult to interpret these estimates. It should, however, be noted that the largest catches in recent years were observed in the southern part of Division 4R and in Subdivision 3Pn, which would explain the increase in the abundance index in Subdivision



3Pn since 1990.

Assessment

If we compare the size structures from the commercial fishery and the summer survey, we can estimate the annual changes in fishing mortality as well as the sizes at recruitment to the fishery. This index shows that 4RST Greenland halibut are fully recruited to the fishery using gillnets with a mesh of 140 mm (5½ inches) at between 41 and 47 cm and that fishing mortality has increased slightly since 1990; however, the low abundance of large Greenland halibut (50 cm) suggests that this resource is being heavily fished. It is unlikely that emigration of adult Greenland halibut out of the Gulf can explain their scarcity. Historical data (fishing and research) from the late 1970s and early 1980s show that nearly half the fish in this population exceeded this size.

The increase in the CPUE of index fishermen between 1991 and 1994 was mainly due to annual recruitment of fish measuring 40-45 cm, which had increased in abundance during that period. The decrease in the CPUE

of index fishermen during the fishing season might have been due to emigration of fish out of fishing areas or a change in the behaviour of fish. If Greenland halibut is fairly sedentary, this monthly decline in CPUE might indicate a high harvesting rate on this stock. The biomass estimate from the summer trawl survey has been relatively stable since 1990, despite heavy fishing, mainly due to juveniles entering the population.

Industry comments

A meeting was held with Greenland halibut fishermen shortly before the stock status review to present the latest scientific information and compare it to their combined knowledge. Fishermen agreed that CPUE increased between 1993 and 1994. They felt that the decrease in CPUE during the fishing season was due to movements of Greenland halibut in the spring and fall, whereas the fish was fairly sedentary in the summer. According to fishermen, the decrease in the size of fish caught and the increase in the percentage of females from 1990 on can be attributed to the shift in fishing effort toward deeper water (400 m, or 200 fathoms) to avoid taking excessive quantities of snow crab, since large Greenland halibut (over 50 cm) tend to occur at depths of over 200 m (100 fathoms).

Prognosis

Abundance indices indicate that the Greenland halibut biomass has been low but relatively stable since 1990. Large Greenland halibut (over 50 cm) are not common in the population, and the number of juveniles observed in the research survey was below average in 1993 and 1994. In the winter trawl survey, carried out on Gadus Atlantica, biomass estimates have been much lower, but relatively stable since the 1980s. In winter, however, Greenland halibut are concentrated in Subdivision 3Pn. The origin of these concentrations is not known. This stock component should be fished with caution until the origin of these fish has been clearly established. Research is currently underway to determine their origin; if it turns out they came from the Gulf, management units will have to be modified accordingly.

The exploitation rate of Greenland halibut in the Gulf is probably high and the small number of large fish means that harvesting concentrates on annual recruitment. In the fall of 1994, the Fisheries Resource Conservation Council (FRCC) recommended encouraging harvesting of Greenland halibut over 50 cm. In 1995, a number of measures were proposed in a two-year plan: increasing mesh size from 140 mm (5½ inches) to 152 mm (6 inches) for 30% of nets, reducing fixed gear quotas by 30% (3,000 t to 2,100 t) and reducing fishing effort by decreasing the number of nets by 20%. In 1996, the mesh size of all nets will be increased to a size to be determined after the end of the 1995 fishing season. These conservation measures may not be particularly efficient if the target size is 50 cm, since only 13% of females are mature at this length. It is thus important to protect immature fish to allow the adult biomass to increase. Moreover, with the new management measures now in force, the current TAC of 4,000 t would spell a considerable increase in fishing mortality in the adult component of the stock

if it were caught. Changes in mesh size should thus be combined with controls on total fishing effort to prevent an increase in the harvesting rate of the adult component. The TAC of 4,000 t is probably too high and maintaining it will not allow the population to rebuild.

Further reading:

Bowering, W.R. 1982. Population dynamics of Greenland halibut in the Gulf of St. Lawrence. J. Northw. Atl. Fish. Sci. 3:141-147.

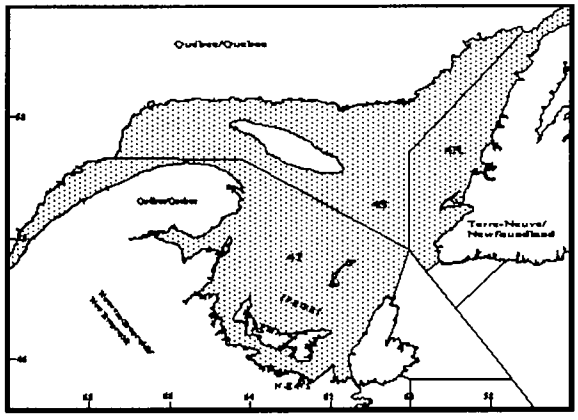
Morin, B, B. Bernier, D. Chabot, et J.J. Maguire 1995. Évaluation et biologie du flétan du Groenland (*Reinhardtius hippoglossoides*) du golfe du Saint-Laurent (4RST) en 1994. DFO Atl. Fis. Res. Doc. 95/59.

Tremblay, C. and F. Axelsen. 1982. Données sur la pêche, la biologie et l'abondance du flétan de Groenland (*Reinhardtius hippoglossoides*) du golfe du St Lawrence. CAFSAC Res. Doc. 80/34:1-27.

Contact/Contacte:

Bernard Morin
Telephone: 418-775-0695
FAX: 418-775-0542
E-Mail: B_Morin@Qc.DFO.Ca

3.6 ATLANTIC HALIBUT - Gulf of St. Lawrence (4RST)



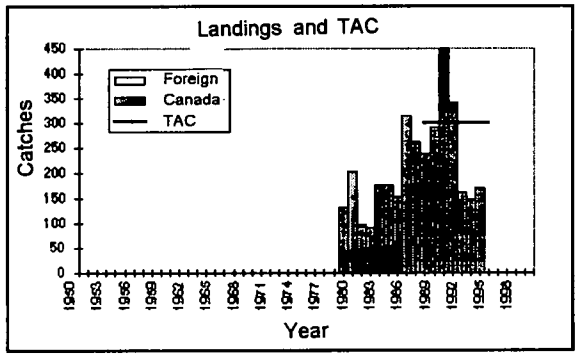
Introduction

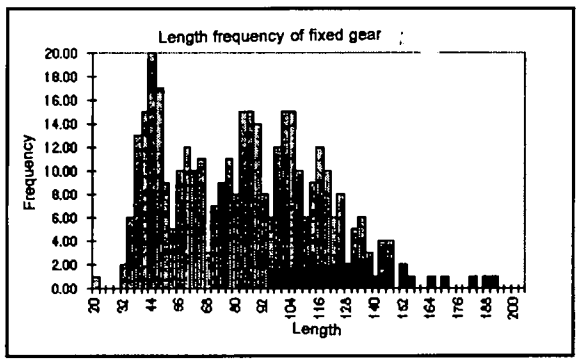
Atlantic halibut is a flatfish which grows quickly (about 8 cm a year) and may reach a size of 2 metres at age 20. Female Atlantic halibut have a faster growth rate and larger maximum size than males. Based on observations from winter trawl surveys in the Gulf, the halibut are ready to spawn at this time. The diet of young halibut consists of invertebrates and fish, while halibut over 80 cm long are almost exclusively fish eaters. Two stocks were identified in the Atlantic area of Canada in 1987 based on marking results and biological information. These are the Gulf (4RST) stock and that of the rest of the Atlantic Coast of Canada (3NOPs, 4VWX, 5Zc).

Description of the fishery

The halibut fishery is a summer fishery dominated by longliners and, to a lesser extent, by by-catches in gillnets and by trawlers. Landings prior to the first TAC were in the order of 300 t. They rose to a record high of 448 t in 1990 and then moved downward, reaching 168 t in 1994. Since 1991, the three divisions (4R, 4S and 4T) have contributed in relatively equal proportion to the total catch. In 1994, the largest landings were made in Quebec, although fishing statistics are probably missing for the west coast of Newfoundland.

In 1988, CAFSAC recommended that individuals under 81 cm be thrown back in order to reduce the mortality of immature halibut. However, this recommendation has never been applied in the Gulf, and only since 1992 outside the Gulf. In 1994, 60% of individuals landed by the commercial fishery in the Gulf measured less than 81 cm. This proportion is similar to catches taken in scientific surveys.





Abundance indices

Research surveys

Very few Atlantic halibut are caught by the various research surveys. A total of 179 halibut were taken during the last 14 annual surveys carried out between 1984 and 1994 on the research vessels Lady Hammond, Alfred Needler, and Gadus Atlantica. The information we can derive is thus limited to sizes and the geographical distribution of catches. The minimum sizes observed in surveys thus ranged from 23 to 50 cm and the maximum sizes from 100 to 200 cm. Halibut taken during the summer were found mainly at a depth of 183 m (100 fathoms) in the northern Gulf.

Assessment

We do not have enough information to determine stock status. The size structure of the halibut population is broad and remains stable. The fishery targets a relatively wide range of year-classes. This indicates that survival is good and that the population is relatively healthy. The proportion of small halibut (34-65 cm) in commercial catches in 1994 suggests that there are one or two good year-classes entering the harvestable population.

Information from the industry

The most frequent comments from the industry had to do with the quality of landing figures. Halibut is a relatively rare species in the Gulf and has a high market value. Fishermen say that by-catches are not always counted in the statistics. Total catches may be larger than indicated by official figures.

An Index Fishermen Program was introduced for the 1995 fishing season to obtain information on the directed fishery for this species, such as catches per unit of effort and depths. A total of 27 fishermen were contacted, 8 in 4R, 2 in 4S and 17 in 4T.

Prognosis

There is no reason to change the TAC of 300 t. We have nevertheless noted that catches are dominated by fish smaller than 81 cm and that this is not an appropriate conservation measure.

Further Reading

Archambault, D. 1995. Le flétan atlantique du golfe du Saint-Laurent en 1994. DFO Atl. Fish. Res. Doc. 95/52.

Contact/Contacte

Diane Archambault
Telephone: 418-775-0705
FAX: 418-775-0542
E-Mail: D_Archambault@Qc.DFO.Ca

3.7 WINTER FLOUNDER in the Southern Gulf

Winter flounder has commercial value in sport and commercial fisheries in eastern U.S., particularly off New England. In the southern Gulf (4T), winter flounder has supported local fisheries for lobster bait and limited food markets. The resource has not been under quota management in 4T. Interest has increased in the exploitation of winter flounder and a directed fishery has developed. Annual landings in 4T have varied widely from year to year, partly due to inaccurate landing statistics. A decline in landings has been noted since 1990. Groundfish surveys indicate regional differences in abundance trends for 4T winter flounder.

Introduction

Winter flounder is a coastal flatfish, common throughout the southern Gulf of St. Lawrence. This resource supports local fisheries for food markets and lobster bait. 4T winter flounder was first assessed in 1993; it is not currently under quota management.

Description of fisheries

Landings of 4T winter flounder totalled 1161 t in 1994 (Figure 3.7.1). Although landings have declined annually since 1991 when 2535 t were reported, this decline is within the annual variability that has been recorded since 1960. Otter trawls contributed most of the landings of winter flounder in 1994 (724 t); gillnets landed 399 t. Landings by seines have declined over the past 10 years, landing only 32 t of winter flounder in 1994. The fishery started late in 1994 because of abundant cod in inshore areas during spring. Landings by mobile gear peaked in September. Most catches came from the southeastern Gulf in unit area 4Tg. The strongest declines in landings occurred in upper Chaleur Bay and near the Magdalen Islands (unit areas 4Tm and 4Tf). A directed fishery for winter flounder has developed with 95% of the landings reported from directed effort. Nominal fishing effort of trawls (number of days fishing) has declined since 1991. Directed effort by trawls on winter flounder totalled 2027 days in 1991 and 865 days in 1994.

	1970-79	1980-89	1990	1991	1992	1993	1994
Landings	1991	1671	2077	2535	1893	1238	1161
TAC	-	-	-	-	-	-	-

Target

No target has been established for 4T winter flounder and it is not under quota management.

Fishery data

Nominal landings of 4T winter flounder have varied widely from year to year, partly because of inaccuracies in the catch reporting. The landings in 1994 were 1161 t, compared to an average of 1961 t since 1960. A decline in landings was noted since 1991; however, this decline may be within the variability in annual landings that has been observed for this

resource. Landings by otter trawls, the main gear component in this fishery, have declined since 1991. Fishing effort by otter trawls has also declined, although effort has become increasingly directed on winter flounder.

Landing statistics for winter flounder are subject to inaccuracies caused by misnaming of species and unreported catches. Unreported catches, mostly destined for bait for lobster traps or personal consumption, are estimated by fishery officers using Supplementary "B" forms. Supplementary "B" landings accounted for 12% of winter flounder landings in 1990, but since then they have contributed less than 3% of annual landings. In 1994, logbooks in the Gulf Region removed the category "flounders" and included the species designation of winter flounder to alleviate the problem.

Ten samples of winter flounder were obtained from the commercial fishery in 1994. Age determination of winter flounder was suspended in 1994 due to difficulties in standardizing methods.

Research data

Research data are provided by groundfish surveys of the southern Gulf, conducted every September since 1971. The average abundance of 4T winter flounder is based on catch in 10 strata where the species is found. Overall, abundance in 1994 appears to be similar to the average over the period 71-94 (Figure 3.7.2). Analyses that take into account the abundance of winter flounder in different strata indicate that there are regional differences in abundance trends for winter flounder in 4T. This is consistent with the view that several stocks of winter flounder are found in 4T. In the Miramichi area, catch rates were relatively low in the 1970s, increased through the 1980s to peak values in 1990-1992 and then declined to intermediate values in 1993 and 1994 (Figure 3.7.3). The abundance of winter flounder in the Magdalen Islands area tended to be high in the 1970s and early 1980's, but has declined in recent years (Figure 3.7.4). No significant trend was found in catches of winter flounder in the Chaleur Bay area, or in the area southeast of Prince Edward Island.

Estimation of stock parameters

Estimates of mortality have not been made on 4T winter flounder.

Assessment results

Current indices of stock abundance, based on research surveys of 4T, indicate that winter flounder is at an intermediate level of abundance relative to data since 1971. Winter flounder in 4T comprise numerous stocks that vary regionally in abundance.

Ecological considerations

Analyses of research surveys of 4T, conducted in various seasons since the early 1980s, indicate that during open-water months, winter

flounder are found inshore concentrated in Chaleur Bay, Miramichi Bay, western PEI, eastern PEI and near the Magdalen Islands. Most of Northumberland Strait has not been sampled by research vessels, although it is considered to be important habitat for winter flounder. During winter, substantially fewer winter flounder were captured at both ends of PEI than during autumn. The decreased abundance of winter flounder at sea during winter is attributed to their movement into estuaries for overwintering. Winter flounder become vulnerable to trap fisheries for smelt that are conducted in river estuaries during winter.

Future prospects

It is not currently possible to quantitatively forecast the abundance of winter flounder. Current indices based on research surveys indicate that 4T winter flounder is at an intermediate level of abundance relative to data since 1971. It appears that several unit stocks of winter flounder occur in 4T and that their abundance varies regionally.

Management considerations

It is important to improve landing statistics for winter flounder by encouraging accurate reporting of each flounder species caught. Improved methods are required for estimating unreported catches destined for bait fisheries and personal consumption.

For more information:

Research Document/Document de recherche: Morin, R., I. Forest-Gallant, J.M. Hanson, R. Hébert and D. Swain. 1995. Status of winter flounder in NAFO Division 4T. DFO Atl. Fish. Res. Doc. 95/60

Contact/Contacte:

R. Morin
Tel: 506-851-2073
Fax: 506-851-2387
E-Mail: morinR@GFC.DFO.ca

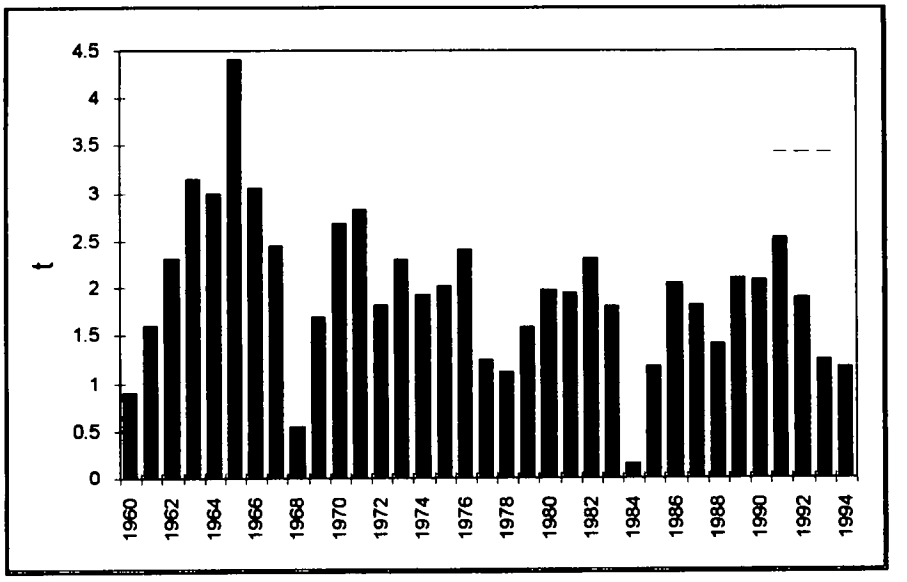


Figure 3.7.1 Winter flounder landings in 1000's of tonnes.
Débarquements de plies rouges en milliers de tonnes.

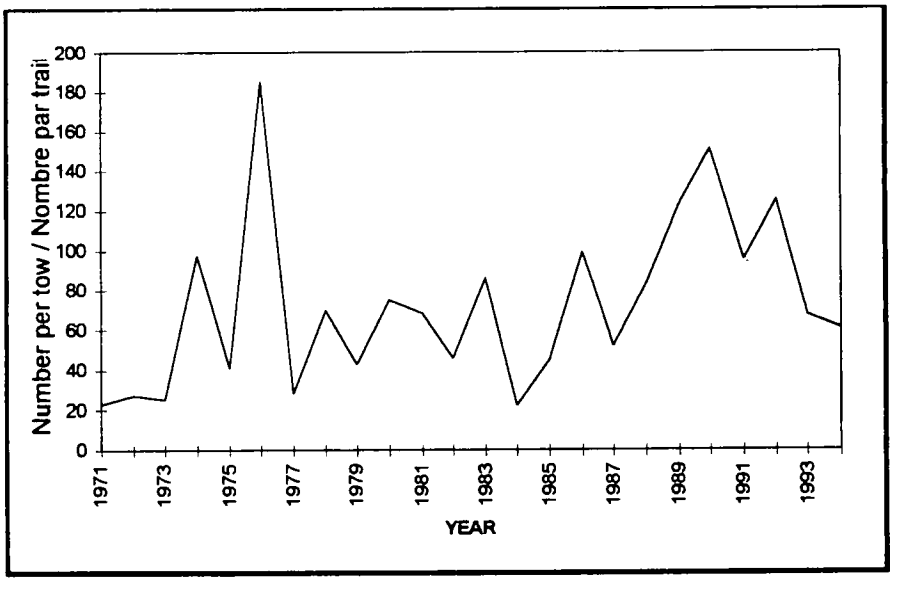


Figure 3.7.2 Winter flounder abundance in research surveys of 4T.
Abondance de la plie rouge dans les relevés scientifiques de 4T.

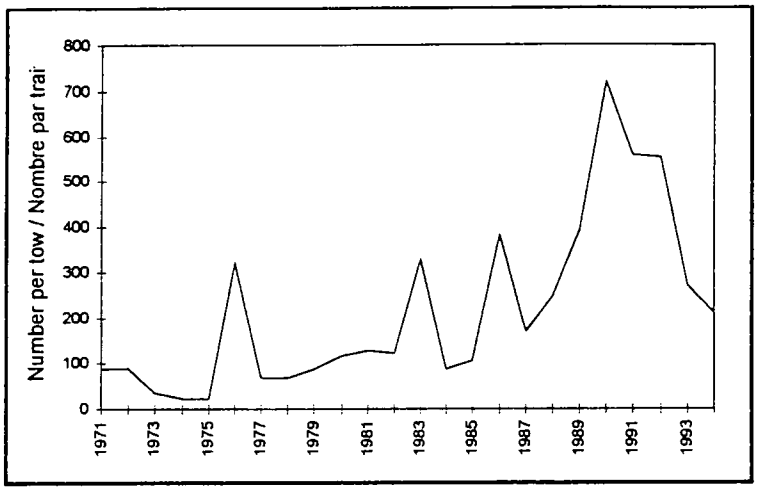


Figure 3.7.3 Winter flounder abundance in research surveys of the Miramichi region of 4T.
Abondance de la plie rouge dans les relevés scientifiques de la région Miramichi de 4T.

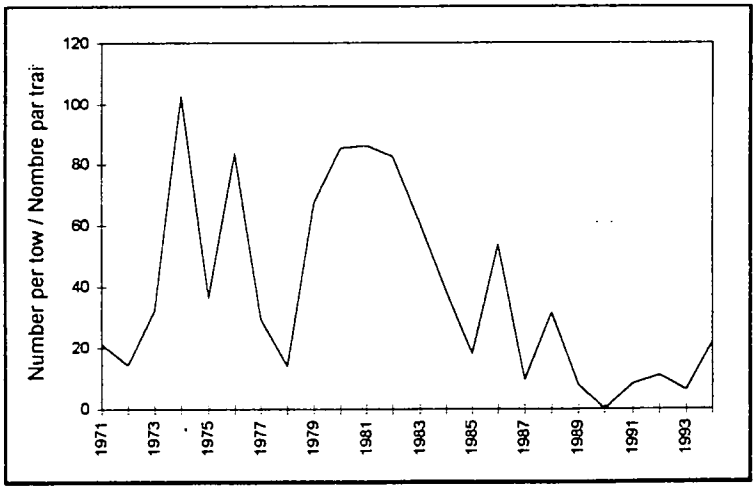


Figure 3.7.4 Winter flounder abundance in research surveys of the Magdalen Islands region of 4T.
Abondance de la plie rouge dans les relevés scientifiques près des Iles de la Madeleine de 4T.

3.8 Witch Flounder in the Gulf of St. Lawrence

The witch flounder fishery in the Gulf of St. Lawrence (4RST) began in the 1950s when Danish seining vessels moved into St. George's Bay, Newfoundland in search of new witch stocks to exploit. The witch fishery that developed was centered in St. George's Bay (4R) in summer, with witch a bycatch of cod and redfish fisheries during winter in the Esquiman Channel (4RS). 4RS became the management unit for witch flounder, even though significant catches were reported during the 1960s from 4T. Total Gulf landings of witch flounder have been dominated by 4T since the mid-1980s. Information on the distribution of witch stocks across NAFO boundaries has contributed to changing the management unit to 4RST. Annual landings of witch have declined throughout the Gulf to their lowest level on record. Groundfish surveys of the northern Gulf indicate declining abundance of witch.

Introduction

Witch flounder is commonly associated with deep areas and channels. In the Gulf of St. Lawrence they are found mainly in channel waters. The management unit for witch in the Gulf was 4RS until 1994. In 1995, it was changed to 4RST.

Description of fisheries

Since 1960, witch landings have averaged 2811 t in 4RST and 1714 t in 4RS. During 1994 seines were the most active gear, contributing 384 t of landed witch in 4RST. In 4RS, most catches were from 4Rd (St. George's Bay) from July to September. In 4T, catches were mostly in 4Tf and 4Tg (eastern Gulf) from May to October. The directed fishery accounted for 81% of witch landings in 4RST in 1994, with 16% of witch landings originating from the plaice-directed fishery. Witch landings in 4RST totalled 448 t in 1994, of which 95 t originated from 4RS. These are the lowest landings on record (Figure 3.8.1).

	1970-79	1980-89	1990	1991	1992	1993	1994
Landings[1]	3780	1997	1272	993	979	901	448
TAC[2]	3500-5000	3500	3500	3500	3500	3500	1000

[1]4RST
[2]4RS

Target

The target corresponds to an exploitation at $F_{0.1}$. The 1994 quota in 4RS was 1000 t.

Fishery data

No sampling data available.

Research data

The DFO Quebec Region has surveyed the northern Gulf annually in August since 1984 and in January from 1978-1994. The southern Gulf has been surveyed by the Gulf Region every September since 1971. All surveys

indicate declining abundance during the late 1980s. Northern Gulf surveys indicate maximum abundance in 1985 or 1986, with current abundance at its lowest since the survey began (Figure 3.8.2). Surveys of 4T indicate that witch abundance declined after 1987, although 1993 and 1994 estimates were in the upper range of abundance observed since 1971. Stock abundance in 4T was low in the early 1980's (Figure 3.8.3). Although the 1993 and 1994 estimates were in the upper range of abundance observed since 1971, this increase may be due to changes in the distribution of witch in the Gulf of St. Lawrence.

Estimation of stock parameters

Estimates of mortality have not been made on Gulf stocks of witch flounder.

Assessment results

Landings of witch flounder in 4RS and 4RST are at their lowest recorded level. The decline in landings has occurred in all gear sectors and in all of the main unit areas of 4RST. Research survey indices from the northern Gulf indicate that the stock is at its lowest level since the late 1980s. The survey index from 4T suggests a similar decline in the late 1980s, with some recovery since 1992.

Ecological considerations

Mapping of catch data from surveys of the northern and southern Gulf suggests that witch flounder straddle the 4RST boundaries in all seasons, but particularly in winter when witch move to deep channel waters in the eastern Gulf. Surveys conducted in Cabot Strait during January 1994 and 1995 indicate that part of the winter distribution extends into 4Vn.

Future prospects

Current assessments of 4RST witch flounder do not provide forecasts of abundance. The abundance of the stock in the northern Gulf appears to be declining.

Management considerations

The 4RST management unit is more appropriate to witch flounder in the Gulf of St. Lawrence in view of their distribution across NAFO boundaries. Previous studies have indicated that more than one genetic stock may be found in the Gulf of St. Lawrence.

For more Information:

Research Document/Document de recherche: Morin, R., G. Chouinard, I. Forest-Gallant, R. Hébert and G. Nielsen. 1995. Status of witch flounder in 4RST. DFO Atl. Fish. Res. Doc. 95/50.

Contact/Contacte:

R. Morin
Tel: 506-851-2073
Fax: 506-851-2387
E-Mail: morinR@GFC.DFO.ca

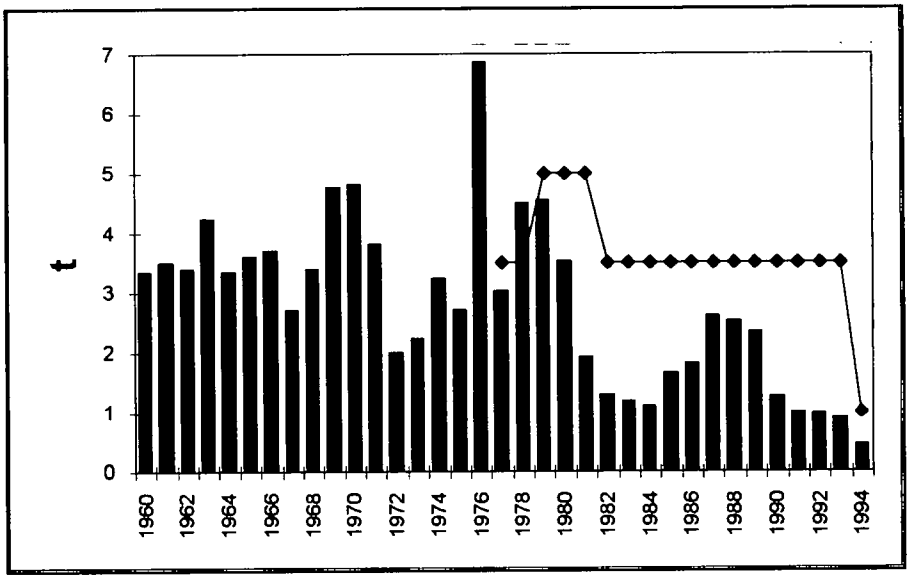


Figure 3.8.1 Witch flounder landings in 4RST and TAC's in 4RS, in 1000's of tonnes.
Débarquements de plies grises dans 4RST et TAC dans 4RS, en milliers de tonnes.

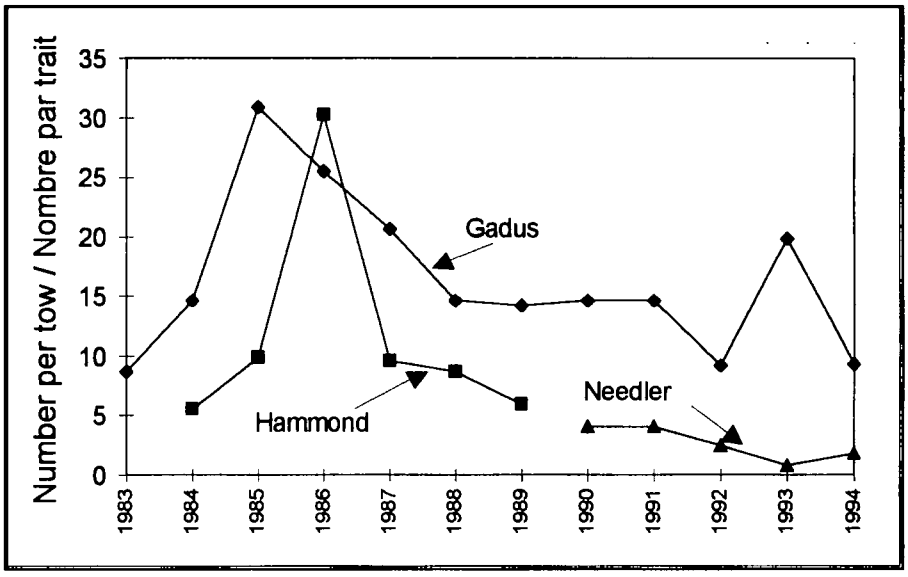


Figure 3.8.2 Witch flounder abundance in northern Gulf research surveys in winter (Gadus) and in summer (Hammond and Needler).
Abondance de la plie grise dans les relevés scientifiques du nord du golfe en hiver (Gadus) et en été (Hammond et Needler).

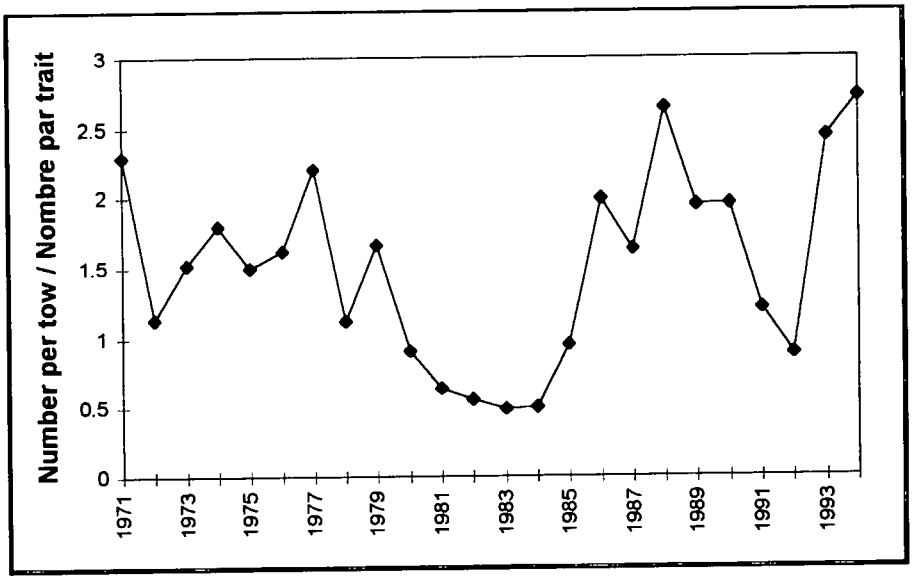


Figure 3.8.3 Witch flounder abundance in southern Gulf research surveys.

Abondance de la plie grise dans les relevés scientifiques

3.9 WHITE HAKE in NAFO Division 4T

The fishery for white hake in the southern Gulf of St. Lawrence (NAFO Division 4T) has historically been the third or fourth most important groundfish resource in this region. Landings in this fishery traditionally peak between July and September and decline through October and November. The hake fishery is carried out mainly by small inshore vessels, and is strongly affected by weather and local market conditions. Both fixed (gillnets and longlines) and mobile gears (small otter trawlers and larger seiners) are used in the hake fishery. The majority of the fishery is conducted in the Northumberland Strait, on the western end of PEI, and between PEI and Cape Breton Island. Abundance is at its lowest level since 1972, there are fewer older white hake and fishing mortality has been very high since the late 1980s.

Introduction

The fishery for white hake in the southern Gulf of St. Lawrence has historically been the third or fourth most important groundfish fishery in this region, with annual landings averaging 5,670 t since 1960. Stock structure and the adequacy of the NAFO Div. 4T management unit have been longstanding issues with this resource. As a result of these uncertainties, a formal analytical assessment (SPA based) has not been conducted since 1989. Since the management unit has not been modified in recognition of the issues mentioned, assessment of this resource continues to be conducted on the NAFO Div. 4T management unit.

Description of fisheries

The TAC was reduced from 3,600 t to 2,000 t for the 1994 fishing season, by recommendation of the FRCC. Frequent, and in some areas almost continuous, closures of the fishery due to high cod by-catch undoubtedly contributed to the record low landings of 939 t in 1994 (nearly 85% below the average for the period 1960-94) (Figure 3.9.1). Since 1960, gillnets and bottom trawls have accounted for 30% and 26% respectively of the landings of white hake, however in 1994, 64% of the landings were taken by longlines and less than 15% were taken by mobile gears.

Views expressed by industry at consultation meetings held (fall 1994) in Grande-Rivière, Québec, Shippagan, NB; and Cap-aux-Meules, Magdalen Islands, indicated that the abundance of white hake has declined. In contrast, industry participants at meetings held in Charlottetown, PEI and Chéticamp, N.S. contended that there was an abundance of white hake in the area, especially in St. Georges Bay, and commented on the increased catch of white hake in lobster traps early in the summer and the impact of cod by-catch restrictions and closures on the amount of fishing effort directed at white hake in 1994.

	1970-79	1980-89	1990	1991	1992	1993	1994
Landings (t)	5.1	7.7	5.2	4.5	3.9	1.5	0.9
TAC			5.5	5.5	5.5	3.6	2.0

Target

The target is a fishing mortality approximating $F_{0.1}$(0.3). The TAC has been reduced on five occasions since the precautionary quota of 12,000 t was placed upon this stock in 1982: 9,400 t for 1987, 5,500 t for 1988, 3,600t for 1993 and most recently 2,000t for 1994.

Fishery data

In 1994, the largest fish at-age were those obtained from gillnets and seines, as was the case in 1993 (there were no samples obtained from otter trawls in 1994). For seines, this difference probably reflects the increase in mesh size that occurred in 1993. In 1994, the mean length and weight-at-age of hake caught by longline was considerably less than that for hake sampled from any of the other fishing gears, especially for hake sampled after July.

Fewer older white hake (i.e., age 6^+ and 8^+) have been caught since 1989. The modal age shifted from age 6 in 1988 and 1989 to age 5 from 1990-93. In 1994 the modal age changed to age 6, but this fishery is now dependent on only 2 to 3 year-classes (ages 4 - 6) and, as a result, it will be sensitive to annual fluctuations in recruitment.

Research data

Results from the 1994 research vessel survey indicate that the abundance and biomass of white hake in NAFO Division 4T continue to be at very low levels. The research vessel abundance index declined slightly from the 1993 level, which represented a reduction of about 50% from the 1992 level (Figure 3.9.2). This index is at its lowest level since 1972. The estimates of population abundance and biomass for 1994 decreased by almost 65% from 1991.

An examination of the length composition of white hake caught during the 1994 survey showed that the abundance of larger white hake has continued to decline and that there are no indications of improved recruitment. Fewer white hake have been caught in the western part of the southern Gulf each year since 1991 suggesting that there has been a contraction of the geographic range in recent years.

Estimation of stock parameters

An analytical assessment of this resource has not been conducted since 1989 due to the lack of a reliable index of abundance and because of uncertainties about stock structure and the adequacy of the NAFO 4T management unit.

Trends in relative fishing mortality (F) at age were estimated by the ratio of catch at age from the commercial fishery to the catch at age in the research survey. The research vessel abundance index data were also analyzed using

a multiplicative model to obtain estimates of average total mortality (Z), using a model with age and year-class as effects.

Assessment results

Both of the approaches used to estimate stock parameters (estimates of relative fishing mortality (F) and average total mortality (Z)) indicate that fishing mortality was high on the year-classes that supported the fishery (ages 4^+) in the late 1980s and continued to increase in the early 1990s.

The divergent views expressed in Charlottetown and Chéticamp concerning the abundance of hake in the southeastern Gulf are also consistent with the results of the 1994 research survey, which found concentrations of hake at the eastern end of the Northumberland Strait and in St. Georges Bay and nowhere else in the southern Gulf.

Ecological considerations

A sampling program in the Miramichi estuary in the fall of 1994 found the by-catch of small white hake in the openwater fishery for smelt and tomcod to be considerable and suggestions for minimizing the by-catch were provided.

Future prospects

A quantitative forecast is not possible. The catches of recent years appear to have resulted in a high rate of exploitation. Rebuilding of this resource will probably occur slowly given the current low abundance and indications of weak incoming recruitment.

Management considerations

In response to recommendations made by the Fisheries Resource Conservation Council, the Minister of the Department of Fisheries and Oceans announced (Dec. 21, 1994) the closure of the fishery for white hake in NAFO 4T. He also announced conservation measures beyond the FRCC recommendations, including the closure of directed fishing for white hake in NAFO 4RS, 3Pn and 4Vn (January to April). Concern has been expressed about the potential for continued exploitation of NAFO 4T white hake during their winter residency in and migration to and from NAFO 4Vn and possibly 3Pn. The evidence from six seasonal surveys conducted in the southeastern Gulf (Sept. 1986 - Sept. 1987) suggest that directed fishing for white hake in NAFO 4Vn before mid-June could result in mortality to white hake that originated in NAFO 4T. As well, fishing in late November and December could have a similar impact.

For more Information

Research Document/Document de recherche: T. Hurlbut, G. Chouinard, G. Nielsen, R. Hébert and D. Gillis. 1995. Status of the Fishery for White Hake (*Urophycis tenuis*, Mitchill) in the Southern Gulf of St. Lawrence (NAFO Division 4T) in 1994. DFO Atl. Fish. Res. Doc. 95/41.

Contact/Contacte:

T. Hurlbut
Tel: 506-851-6216
FAX: 506-851-2387
E-Mail: HurlbutT@GFC.DFO.ca

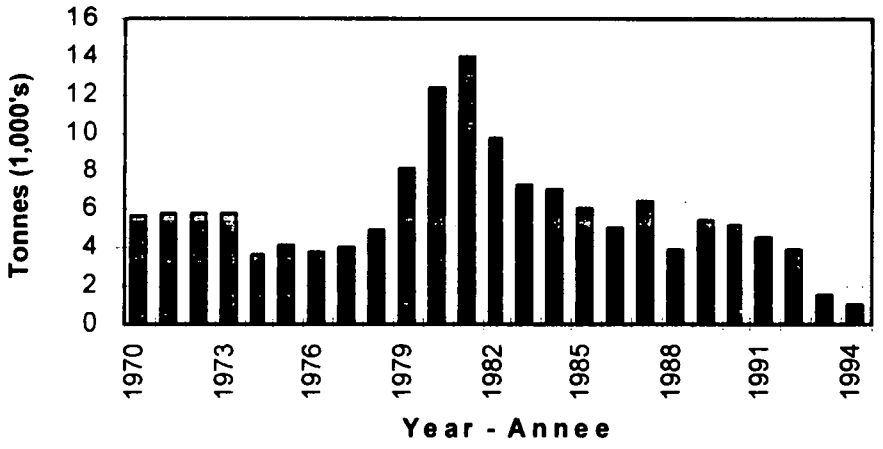


Figure 3.9.1 **Landings of white hake in NAFO Division 4T.**
Debarquements de merluche blanche dans la division 4T de l'OPANO.

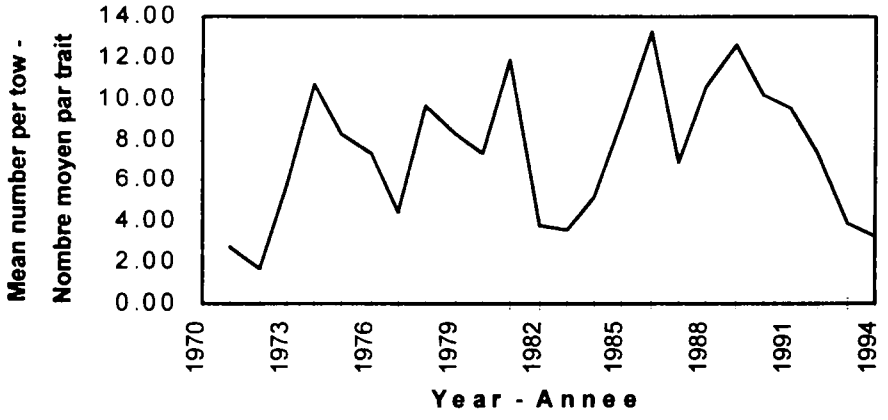


Figure 3.9.2 **Research vessel survey mean number per tow for white hake in NAFO division 4T.**
Nombre moyen par trait fait par les navires de recherche lors des releves sur la merluche blanche dans la division 4T de l'OPANO.

3.10 SPINY DOGFISH in NAFO Division 4T

The spiny dogfish is a highly migratory, small pelagic shark that has generally been regarded as a "nuisance" by Maritime inshore fishers because of the damage they cause by consuming bait, damaging longlines and gillnets and devouring hooked or netted fish. Opinions about the extent of the "nuisance" caused by spiny dogfish have moderated to a certain extent with the establishment of markets and directed fisheries in certain areas of its range, including the Gulf of St. Lawrence, especially during the recent declines and closures in traditional northwest Atlantic groundfish fisheries.

Historically, directed fisheries for sharks have tended to be characterized as "boom and bust" enterprises, because populations are usually rapidly reduced to levels that will not support the fishery.

Studies, of the stock structure of spiny dogfish in the northwest Atlantic suggest that there is one stock (NAFO Subareas 2-6) that undergoes large seasonal migrations.

Research vessel data suggest that the abundance of spiny dogfish in the southern Gulf has been increasing since 1987.

Introduction

Although spiny dogfish have historically been regarded as nothing more than a nuisance by inshore fishers, the relatively recent development of markets for dogfish products from North America has resulted in the establishment of directed fisheries in the northwest Atlantic, including the southern Gulf of St. Lawrence, where landings have increased significantly since 1990. The available evidence from tagging, distributional and genetic studies suggests that there is one stock of spiny dogfish in NAFO subareas 2-6 which undergoes large, annual seasonal migrations. Shark populations, especially dogfish, are considered extremely vulnerable to overexploitation because of their slow growth, considerable longevity and low reproductive capacity (i.e., long gestation period and low fecundity). In view of these recent developments and because of the potentially significant negative impact of spiny dogfish on other species, particularly of commercial species the status of this resource in the southern Gulf of St. Lawrence was reviewed.

Description of Fisheries

There are no TACs for the Canadian Atlantic dogfish fishery. In the southern Gulf of St. Lawrence (NAFO Div. 4T), where the majority (80%) of the landings of spiny dogfish (1989-94) have been taken by gillnets, annual landings did not exceed 15 t until 1990 when 615 t were recorded. The landings dropped to 142 t in 1991 after which they grew steadily to a peak of 970 t in 1994 (Figure 3.10.1).

	1970-79	1980-89	1990	1991	1992	1993	1994
Landings	3	26	615	142	192	537	970

Target

No target has been identified.

Fishery Data

Samples from the commercial fishery have only been obtained opportunistically. Examination of the length frequencies reveals that virtually all of the male dogfish sampled were sexually mature (> 60 cm), however a significant proportion of the females were probably immature. Generally, the size range of dogfish was limited (58-88 cm for males and 62-96 cm for females) and may be indicative of the tendency for this species to form schools based on size.

Research Data

Spiny dogfish were not captured in the surveys of the southern Gulf conducted from 1971-83 (Figure 3.10.2). No consistent patterns were apparent in the distribution of dogfish catches in surveys of the southern Gulf except for the occurrence of concentrations off the eastern and western coasts of P.E.I. since 1991 and the occurrence of concentrations off the Acadian Peninsula since 1992.

The mean number per tow in the annual research survey rose after 1987 and peaked at 11.8 fish per tow in 1993 but decreased sharply to 2.7 in 1994. With the exception of 1990 and 1992, substantially more males than females have been caught in the surveys since 1985. Examination of the survey length frequencies revealed that the majority of male dogfish sampled were sexually mature, whereas most of the females were probably immature.

Estimation of Stock Parameters

The estimation of stock parameters for transboundary fish species like spiny dogfish will require joint assessment by Canada and the U.S.

Assessment Results

Research vessel data from surveys of the southern Gulf (NAFO Div. 4T) suggest an increase in abundance since 1987.

Data and analyses presented during the most recent (1994) assessment of spiny dogfish in the northwest Atlantic (NAFO Subareas 2-6) by the U.S. National Marine Fisheries Service indicate that total landings from this resource have increased five-fold since 1987. Total catches may have been 2/3 or more higher than the reported landings, when recent estimates of discard rates in U.S. fisheries are considered.

The results of the U.S. assessment of this resource suggest that this stock may be fully utilized with respect to the level of fishing mortality and that the current fishery which mainly targets mature females will result in reduced longterm recruitment.

Ecological Considerations

Spiny dogfish are opportunistic feeders that consume whatever organisms are most readily available, with small fishes usually predominating. Predation by spiny dogfish is probably a significant source of mortality for commercially important species. Preliminary analyses conducted by the U.S. National Marine Fisheries Service indicate that the biomass of commercially important species consumed by spiny dogfish may be comparable to the amount harvested by fishers.

Future Prospects

Spiny dogfish are a transboundary species that are felt to constitute a single unit stock in the northwest Atlantic (NAFO Subareas 2-6). Consequently, quantitative forecasts for this resource will require the consideration of information from throughout the current management unit. Analyses presented during the most recent (1994) assessment of this resource by the U.S. National Marine Fisheries Service indicate that given the relatively stable level and distribution of the exploitable stock, and recent increased targeting, landings in 1995 will likely exceed the 1993 landings of 22,000 t.

Management Considerations

Given the evidence for a single unit stock in the northwest Atlantic (NAFO Subareas 2-6), joint assessment and management of this resource by Canada and the U.S. should be considered.

For more information:

Research document/Document de recherche: T. Hurlbut, G. Nielsen, R. Hébert et D. Gillis. 1995. The status of spiny dogfish (*Squalus acanthias, Linnaeus*) in the southern Gulf of St. Lawrence (NAFO Division 4T). DFO Atl. Fish. Res. Doc. 95/42.

Contact/Contacte:

T. Hurlbut
Tel: 506-851-6216
FAX: 506-851-2387
E-Mail: hurlbutT@GFC.DFO.ca

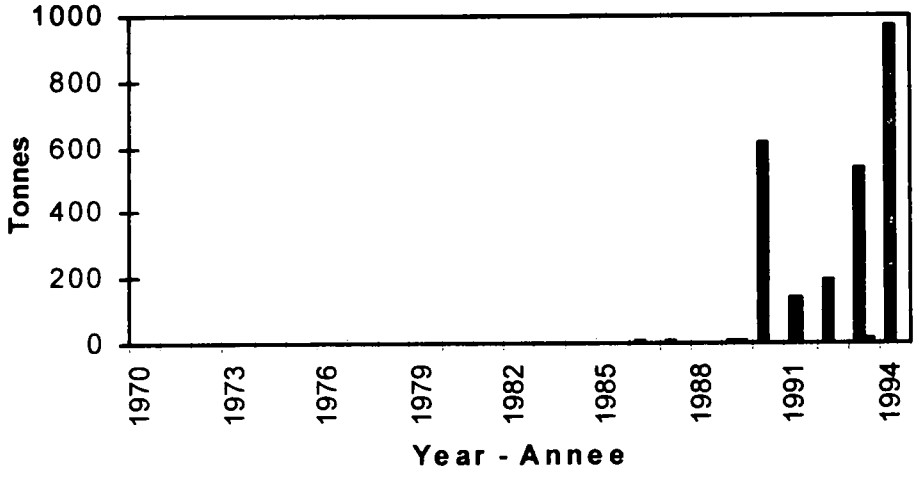


Figure 3.10.1 **Landings of spiny dogfish in NAFO Division 4T.**
Debarquements d'aiguillat commun dans la division 4T de l'OPANO.

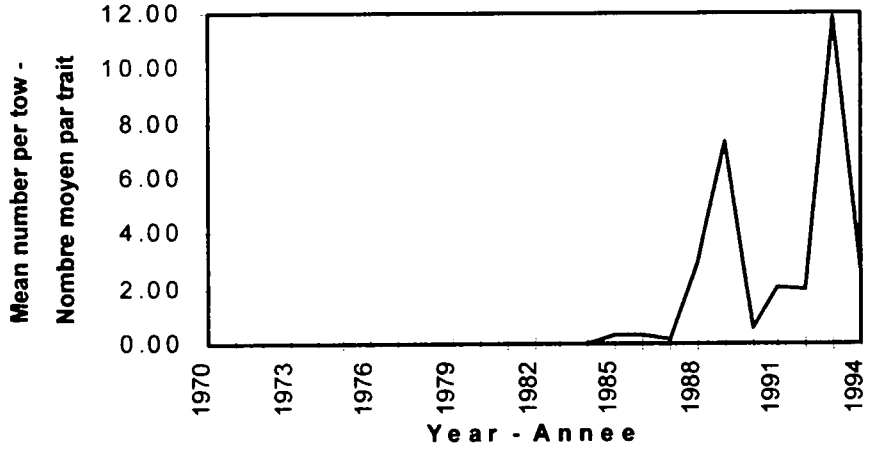


Figure 3.10.2 **Research vessel mean number per tow for spiny dogfish in NAFO division 4T.**
Nombre moyen par trait fait par les navires de recherche lors des releves sur l'aiguillat commun dans la division 4T de l'OPANO.

4. The utility of the summer survey in 4Tl as a pre-recruit index for cod

Introduction

The ability to make useful catch projections requires accurate information on strength of incoming year-classes. A research survey was initiated in the principal nursery area of southern Gulf of St. Lawrence cod in 1990. Subsequently, a multiplicative model using the September groundfish survey has been shown to provide and index of pre-recruit abundance (starting at age 2). Although the time period is very short, only five years, this study shows that the summer survey in 4Tl provides an independent index of pre-recruit abundance (ages 2 to 4).

Research data

Research surveys were conducted in NAFO unit area during early August 1990 (*CSS J. L. Hart*), early August 1991 (charter *m/v Anita Bernard*), early July 1992 (*CSS E. E. Prince*), early July 1993 (*CSS E. E. Prince*), and early July 1994 (*CSS Calanus II*). The same nets, same bridles, similar doors, and same warp length to water depth ratios were used in all surveys but comparative fishing experiments were not possible. The surveys followed the standard stratified random survey design used by the Gulf Region. There were four depth strata (8.1-16.0 fm, 16.1-24.0 fm, 24.1-32 fm, and 32.1-40 fm) divided into 3 X 3 nm sampling sites (each identified by its center point). Between 40 and 50 stations were attempted in each survey. Mean numbers per tow (by age) were obtained using the survey analysis program RVAN.

Estimation of parameters

Two types of evaluations were performed: correlation analysis with the SPA and application of multiplicative models similar to that used in the September survey.

Correlations were performed between mean numbers at age in the survey and SPA numbers for that year (n = 5) as well as for age + 1 the following year (same year-class but one year older; n = 4).

An index of year-class strength was modelled using a multiplicative model based on mean number at age per stratum, stratum, stratum*age interaction, and year of survey.

Results

The mean numbers at age from the summer survey were consistent with those from the September survey; there has been no strong recruitment in recent years. The 1987 year-class was identified to be the only one that was moderately strong whereas the 1992 year-class appeared to be particularly weak.

The small number of years limited identification of significant relations to those of $r > 0.88$ for direct correlations of number at age in the summer survey with numbers at age in the SPA for the same year. The threshold

significance level was $r > 0.95$ for numbers at age in the summer survey in one year with those at age +1 in the SPA the following year. The data from the summer survey performed slightly better than those from the September groundfish survey for the same years. Numbers at age 3 in the summer survey was significantly correlated with age-3 in the SPA for that year. In contrast, the relationship based on the September survey (all strata) was not significant. In terms of predicting one year ahead, age-3 numbers in the summer survey predicted age 4 numbers the following year and relationships using ages 4 and 5 to predict numbers in the SPA the following year were almost significant (r = 0.89 for both). In contrast, no significant correlations were identified for the September survey although the correlation coefficients also approached statistical significance (r = 0.76 to 0.94).

The multiplicative model explained 79% of the variation in the data. The stratum ($P <$ 0.0001), age ($P < 0.0001$), and stratum*age (P < 0.001) effects were highly significant. The stratum*age interaction represents the real tendency for younger age-groups (especiallly age 1 and 2) to be found almost exclusively in the two shallowest strata. The estimates of year-class strength were not, however, significantly different from each other (P = 0.237). This is partly due to a lack of contrast in the data (the 1988 to 1992 year-classes have been estimated to be very weak) and the few years of data available. The 1987 year-class was clearly larger than the subsequent year-classes but was not well estimated by the model because it was not seen until age-3 in 1990, the first year of the summer survey (i.e., the year-class is incompletely estimated in the model due to missing data for numbers at age 1 and 2). As more years of data are added and variation in year-class strength increases, the model will be better able to detect significant differences in year-class strength.

Management considerations

In addition to providing an independent index of cod pre-recruit abundance, this survey also yields information on cod maturity at size and age that can not be obtained from the September survey, information on seasonal variation in body condition of cod, biological samples from many fish species used in describing cod diets and interspecific interactions (potential competitors and predators), and may provide the only index of winter flounder abundance for the southern Gulf.

The summer survey is more variable than the September survey because it does not cover the entire stock area. Nevertheless, the indices of year-class strength were similar to those obtained during the September survey and, when sufficient years of data are collected, the index should be included in the calibration of the SPA as an independent index (similar to how the CPUE index is currently used).

For more information

Research Document/Document de recherche: Hanson, J.M. 1995. Evaluation of the utility of summer trawl surveys (1990 to 1994) in the Shediac Valley (NAFO unit area 4Tl) as an index of pre-recruit abundance for southern Gulf of St. Lawrence cod. DFO Atl. Fish. Res. Doc. 95/51.

Contact/Contacte:

M. J. Mark Hanson (Ph.D.)
Tel: 506-851-2047
Tel: 506-851-2387

5. Cod-plaice Interactions

Introduction

Atlantic cod (*Gadus morhua*) and American plaice (*Hippoglossoides platessoides*) are the dominant groundfish species (in terms of biomass) in the southern Gulf of St. Lawrence. Both species have shown marked changes in size-at-age and abundance since 1971. The goal of this study was to examine indirect evidence that cod and plaice compete for food by showing: substantial overlap in distribution and diet; an inverse relationship between abundances of the two species; and that changes in growth of both species that are consistent with the occurrence of interspecific competition.

Research data

American plaice abundance (age 3 and older) was derived from the September research survey from 1971 to 1994. Atlantic cod abundance (age 3 and older) was derived from sequential population analysis. Ages were determined from otoliths. Stomachs (frozen) of cod and plaice were collected during research surveys, primarily from the western half of the Gulf. Prey were identified to various taxonomic levels, counted, and prey in each taxonomic group weighed.

Methods

Overlap in distribution was examined by plotting and comparing catches per standardized tow of cod and plaice from the September 1993 research survey.

Diets of arbitrarily defined size-classes (e.g., 5.0 to 9.9 cm, 10.0 to 14.9 cm, 15.0 to 19.9 cm) were summarized (based on weight) for concurrently collected samples from August 1991, July 1992 and 1993, and September 1991 to 1993.

Diet overlap between the various size-classes of cod and plaice was measured using Schoener's overlap index (Schoener 1971):

$$\alpha = 1 - 0.5\left(\sum_{i=0}^{s} | P_{ki} - P_{yi} |\right)$$

Where / où:

P_{ki} is the proportion of food type i in the diet of species k,

P_{yi} is the proportion of food type i in the diet of species y, and s in the total number of food types

Proportions in the diet were based on weight of all prey eaten by a size-class of fish.

Least squares regression was used to examine relationships between: cod and plaice abundance; cod size-at-age and condition with cod abundance (numbers in January from SPA); and plaice size-at-age with plaice abundance and cod abundance.

Results

Cod and plaice distributions overlapped broadly during September 1993. Cod were caught in nearly all sets where plaice were caught whereas plaice were not caught in shallow waters where cod were caught.

The diet of cod < 35 cm long was dominated by mysids and gammarid amphipods. Fish were the principal prey of cod > 55 cm long. Cod of intermediate size ate mysids, shrimp, small fish, and toad crabs. Echinoderms were seldom eaten by cod.

The diet of plaice < 30 cm long was dominated by mysids (60 to 98 % of diet weight) and gammarid amphipods. Plaice > 30 cm long ate brittle stars, sand dollars, sea urchins, clams, and Iceland cockles. Fish, shrimp, and crabs were seldom eaten by plaice.

Diet overlap was high (Shoener's index > 0.5) between cod 5 to 35 cm long and plaice < 35 cm long. Diet overlap was moderate (Shoener's index >0.3 but < 0.5) between cod 40 to 50 cm long and plaice < 35 cm long. Diet overlap was low (Shoener's index < 0.2) between cod > 50 cm long and all sizes of plaice. The diet of plaice > 35 cm long overlapped very little (Shoener's index < 0.1) with that of any size-class of cod.

Based on the September research survey, American plaice abundance was high during the mid- to late-1970s, declined to low levels by 1985, rose slightly from 1989 to 1991, and declined slightly from 1992 to 1994. Based on sequential population analysis, Atlantic cod abundance declined to low levels by 1975, increased until about 1985, declined continuously to the early 1990s, and has remained fairly stable the last three years.

Weights at age (age 5 or 6 and older) of plaice were high during the 1970s, declined during the early to mid-1980s, increased slightly during the late 1980s, and changed little during the 1990s. Weights of age 3 and 4 plaice have varied little over the time series.

Cod weights at age (age 4 and older) increased from 1971 to 1980, declined to about 1987, and increased slightly since then. Weights of

age 3 cod varied little over the time series.

Ecological Interactions

The wide distributional and dietary overlap between cod and plaice suggest competition for food is possible when food is in short supply. Plaice abundance was inversely correlated ($r^2 = 0.69$) with that of cod, which suggested cod were competitively dominant over plaice. Cod growth (age-5 and older; $r^2 = 0.34$ to 0.76) and condition (weight of 60 cm cod; $r^2 = 0.62$) were inversely correlated with cod abundance, which is consistent with intraspecific competition for food. Plaice growth (age 6 and 7) was not correlated or positively correlated (ages 8 to 12; $r^2 = 0.20$ to 0.27) with plaice density. This result is not consistent with intraspecific competition for food but is consistent with competitive release following a decrease in abundance of a dominant competitor. Furthermore, plaice growth was inversely correlated (ages 6 to 12; $r^2 = 0.27$ to 0.71) with cod abundance, which is consistent with asymmetrical interspecific competition for food with cod. The cod and plaice growth data are consistent with the abundance data that suggested cod were competitively dominant over plaice.

Contact/Contacte

M. J. Mark Hanson (Ph.D.)
Tel: 506-851-2047
FAX: 506-851-2387
E-Mail: hansonM@GFC.DFO.ca

6. Cod-Lobster Interactions

In the past, Atlantic cod feeding studies have not found evidence of any significant lobster consumption but samples from past studies were taken primarily from offshore regions where lobster traditionally do not occur. In 1994, lobster fishermen reported an increased abundance of cod in their lobster traps. Fishermen have previously reported on several occasions that cod is a predator of lobster. To examine this issue, samples were collected in 1994 from inshore waters.

Atlantic cod, Greenland cod, ocean pout, longhorn sculpin, shorthorn sculpin and cunners caught in lobster traps during the spring lobster fishery in the Val Comeau (Lobster Fishing Area 23), North Lake and Tignish (Lobster Fishing Area 26B) areas were examined. As well, samples of cod caught inshore during summer by a longliner near Margaree and by a research trawler near Miscou were examined. A total of 233 specimens including 84 Atlantic cod, 80 Greenland cod, 17 ocean pout, 7 longhorn sculpin, 12 shorthorn sculpin, and 34 cunner were sampled.

In the 233 fish examined, the thorax of one lobster was found. It came from an Atlantic cod of 56 cm in length collected off North Lake. It was apparent that most fish found in the lobster traps were seeking the bait, in this case herring. For cod as for other species, bait (herring) constituted a significant portion of the diet. Other items found in the stomachs included crabs, worms and small crustaceans.

This limited study suggest that cod feeding on lobster is low but fishermen suggest that lobster may be more vulnerable during summer when moulting and that the predation at that time of the year may be significant. Predation of moulting lobster may occur during this period but it is likely to be restricted both in time and in area as the warm water found nearshore on lobster grounds are probably too high for cod. Further sampling during summer will be required to determine the extent of possible predation during summer.

Contact/Contacte:

Ghislain Chouinard
Tel: 506-851-6220
Fax: 506-851-2387
E-Mail: chouinardG@GFC.DFO.ca

7. Comparison of relative fishing mortalities for cod, white hake and American plaice

Cod, white hake and American plaice are the three main commercial groundfish species in the southern Gulf of St. Lawrence (4T). Over the years and until 1993, cod has dominated the landings and has been the main directed species in the area. Although the other two species are caught in directed fisheries; a significant portion of their landings originate from by-catch in the cod fishery.

The similarity in the relative fishing mortalities obtained from the ratio of catch at age divided by the research vessel population estimates at age for the three species was examined. In this analysis, for each year, a relative F estimate was calculated by dividing the total commercial catch at age for fully recruited age classes by the research vessel population estimates for the same age classes. For each species, the age of approximate full recruitment to the fishery was first determined by a cursory examination of the catch at age matrix.. For cod, age 7+ were used while age 5+ and age 10 + were used for white hake and American plaice respectively. Once calculated, the resulting estimates were compared by correlation analysis.

The results indicate that the trends in fishing mortality for white hake and cod are very similar over the period 1984 to the present. It was noted that the correlation is dominated by the high 1992 value. This value may be a survey effect, where both species were more catchable. Further analyses are required but these results suggest that management measures designed for cod have implications for hake as well and vice versa.

Contact/Contacte:

Ghislain Chouinard
Tel: 506-851-6220
FAX: 506-851-2387
E-Mail: chouinardG@GFC.DFO.ca

8. Considerations on re-opening a closed fishery

In 1994 and early in 1995, some discussions led by the Fisheries Resource Conservation Council (FRCC) took place on considerations on re-opening a closed fishery. We consider that this represents a good start in developing a process and criteria for re-opening a closed fishery. In particular, involving the stakeholders and the need for partnership are important considerations which have been neglected in the past. Several "stock health" indicators including total biomass, spawning biomass, and age structure of the biomass were suggested as important considerations. We agree that they are but suggest the addition of stock production to the list. If individual growth rates and recruitment are low then the production of biomass will be low. If a fishery is re-opened when production is low, the other stock health indicators may quickly fall below critical levels. As indicated during the discussions, there is much work to be done to define these criteria more clearly and to examine alternative rules for re-opening. This will require detailed analysis.

There is one consideration however, which we would argue needs to be strengthed. It is sometimes stated that only biological criteria need to be examined in deciding to re-open a fishery. On the contrary, we would argue that management criteria should be considered as well in deciding to re-open a fishery. The declines in many Canadian resources can be linked to fishery objectives and/or harvesting rules that were not compatible with conservation. Fishing mortality was allowed to remain well above operational targets to satisfy economic and social fisheries objectives. Harvesting rules allowed for quota transfers among fleets when the quota shortfalls should have provided a signal that stocks were in decline. It would be naive from a conservation perspective to re-open a fishery where the biological signals are favorable but to the same size fleet that overfished the stock in the first place and using the same management regime as before.

One of the general conservation objectives suggested is " to manage the pattern of fishing over the size and ages present in fish stocks, catching fish of optimal size ". We think that this is important but secondary compared to the need of matching fishing effort to stock potential.

This can be illustrated by examining two cases: one where fishing effort is matched to stock potential and one where it is too high. The pattern of fishing over the size and ages is optimal in both cases. In the case where fishing effort is too high, even if the best mesh size is used, the fishery will be strongly influenced by fluctuations in recruitment. Catch rates will drop rapidly when a poor year-class comes in and a succession of poor year-classes could mean a closure of the fishery. In this case, the stock may not be in danger but the fishery is no longer viable; in the end the result for industry is the same. Even with the best mesh size, this fishery will be characterized by fewer year-classes contributing to the fishery. In the case where

fishing effort is matched to stock potential, declines due to poor incoming year-classes would be attenuated.

Some segments of the industry believe that there is no need to reduce fishing effort providing that the appropriate mesh size is used and illegal modification of fishing gear (restriction of the openings of the meshes) does not take place. Some also advocate that proper selectivity by itself is the salvation of the fishery. This concept has to be refuted. Scaling the effort to the potential of the stocks is the key to conservation; appropriate selectivity is very important but it is not the panacea to fishery collapses.

It is possible to determine the level of effort that a stock can safely sustain. For a given stock, this level will generally be constant through time once technological improvements or improvements in efficiency are accounted for. Discussions of re-opening a fishery should include consideration of specific effort levels (hours, days, trips) which will ensure that the stock indicators do not fall immediately or even gradually below the passing mark.

Fishing effort could be another stock health indicator. Annual fishing effort could be monitored, much the same as catch, to ensure that over-exploitation does not occur. Little attention was given to estimating effort in the past and problems with stock assessment models (e.g. retrospective patterns) camouflaged steep declines in many stock sizes. In hindsight it is clear that the level of effort increased to dangerous levels in the late 1980s and early 1990s. The increase in fishing effort could have been seen as a definite sign of danger. In fact, fishing effort could be a predictor of future stock health. If a stock is considered "healthy" but fishing effort is high or increasing; the stock health can be expected to decline in the near future.

Fishing effort can also be used as another metric to manage fisheries. TACs, which have been the main tool to manage fisheries, are an indirect method of regulating effort. Up to now, these have not been very successful for a variety of reasons including misreporting, discarding, stock assessments precision., etc. We propose that nominal fishing effort be used in conjunction with TACs to manage fisheries. This approach was presented at the Forum on the Management of 4T and 4Vn cod held in October 1994 in Moncton (Chouinard et al. 1995).

TACs are established annually and are often based on the most recent assessment of the stock. Suppose that in a given year, an assessment gives an overestimate of stock abundance. If, in addition to the TAC, there is a limit on the effort (let's say a season is established), the TAC will not be reached since it was too high relative to the real stock abundance. On the other hand, if the TAC is reached much earlier than the end of the season, it is possible that the stock abundance was underestimated or that vessels got more efficient gear. A management strategy that would use both the TAC and direct fishing effort restriction at a safe biological exploitation level would be more prudent than using only one or the other. In addition, an appropriate level of effort would make other

management measures such as small fish protocols and strict enforcement of mesh sizes less critical to the maintenance of the stock.

Because the level of effort required to exploit a stock, say at $F_{0.1}$, is a constant, this value can be constantly refined and updated as more information becomes available. Increases in efficiency could be examined by comparing historical fishing mortality generated by sectors of the fleet and the level of effort expended. Some would argue that there are difficulties in doing these calculations and we agree, but those difficulties are in our view no greater and likely less important than those that have become apparent in a system where TACs alone are used to manage the fisheries. Part of the assessment work could be directed at estimating the amount of fishing effort required for a rational exploitation of the stock (see Sinclair et al. 1994 for example).

For more Information

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Contact/Contacte:

G. Chouinard
Tel: (506) 851-6220
FAX: (506) 851-2387
E-Mail: chouinardG@GFC.DFO.ca

A. Sinclair
Tel: (506) 851-2721
Fax: (506) 851-2387
E-Mail: sinclairA@GFC.DFO.ca

9. Consultations

9.1 Groundfish Stocks November 15, 1995 Grande-Rivière, Québec

Personnel from the Department of Fisheries and Oceans, Science Branch, Gulf Region presented an overview of the data on the groundfish stocks of the southern Gulf of St. Lawrence collected during 1994 including a summary of catches and the preliminary results of the September Groundfish survey. The objective of the meeting was to obtain the views of fishermen and the fishing industry on the status of the various groundfish stocks. These observations and comments will be considered in the preparation of the assessments of the status of these stocks. The following represents a summary of the main points made by participants during the meeting.

Environmental Conditions

- in 1994 winds were not as strong as in the past few years.
- conditions were felt to be generally warmer in 1994.
- fishermen pointed out that they could collect oceanographic data if DFO could supply instruments.

Commercial fisheries

- maps of fishery distribution from observer data and logbooks were presented.
- some flatfish (winter flounder and plaice) fisheries in the Baie des Caleurs that took place in late September-October did not appear on the maps.
- an experimental fishery to determine the level of harbour porpoise by-catch by gillnets took place off Miscou.
- the shrimp fishery near Cap-des-Rosiers in 1994 is new. This area was not previously fished commercially but some good concentrations were found there in 1994.

Cod

- the general consensus was that cod abundance is low. Few cod were reported to be caught in the turbot fishery between Rimouski and Matane. There was a decrease around Bonaventure Island. One fisherman indicated that he only caught 3 cod between June 1 and September 15, north of Anticosti.
- there were a few dissenting opinions. One fisherman indicated there were lots of cod in the Estuary. An increase in the catches of the recreational fishery around Newport was also reported.
- some fishermen indicated that it was difficult to determine the level of abundance because they did not fish in 1994.
- there were severe by-catch restrictions in 1994 which prevented the catch of cod.
- one fisherman reported that cod did not appear to be in good condition (appeared to be sick)
- low recruitment for cod may be caused by

seal predation.

- the recreational fishery was not felt to have been sufficiently controlled. Landings in that fishery are likely underestimates as some landed more than 10 fish. Some discarding also took place in 1994 (20-25 fish are caught but only 10 are landed).

Plaice and Winter flounder

- winter flounder is found in shallower waters.
- discarding of these species still takes place.

White hake

- fishermen reported a large decline in the abundance of this species.
- hake used to be caught as a by-catch in the redfish fishery along the edge of the Laurentian Channel but this has decreased recently.
- small hake are found along the edge of the Laurentian Channel.
- in winter, hake are found in deeper waters than cod.

Dogfish

- abundance of dogfish has been high since the mid to late 1980s.
- abundance of dogfish was high during the summer but decreased during September
- dogfish are found in shallow waters near herring spawning beds.
- a fisherman reported that dogfish had been abundant in the late 1940s and early 1950s in the area but then disappeared around 1954/1955. He wondered about the effect of the Canso Causeway.
- because dogfish is a migratory stock, an agreement should be worked out with the U.S. for its management.
- fishermen request more information on dogfish.
- an exploratory fishery took place along the Gaspé coast during 1994.
- it was reported that a study of the diet of dogfish had been commissioned by the Regroupement des pêcheurs professionnels du sud de la Gaspésie. About 400 dogfish had been examined. Some of the prey species included squid, crab, lobster, cod and herring. A report is in preparation.

Seals

- fishermen consider that seals are the cause of the decline in cod recruitment.
- there should be a seal hunt or cull.
- fishermen would be willing to collect seals for diet analysis.
- they report that seals appear when capelin and herring arrive on the spawning grounds.

Participants

Donat Albert	Newport	777-2917
J.-C. Grégoire	Grande-Rivière	385-4185
W. Sevigny	Cap D'Espoir	782-2722
Louis Beauchamp	Newport	777-2286
Lomer Allain		396-5804
Gérald Beauchamp	Newport	777-2297
Jocelin Beauchamp	Pabos Mills	689-4521
Onil Cyr	Grande-Rivière	385-2422
Martin Castillou	Newport	777-2773
Bertrant Cassirn	Anse Aux Giffon	892-5564
Raoul Grenier	Newport	777-2352
-	Newport	777-2235
Stéphane Beauchamp	Newport	777-2710
Jean-François Martel	Cap D'Espoir	385-2073
Alexandre Bernatchez	Grande-Rivière	385-2077
Oneil Cloutier	Percé	782-5258
Claude Beauchamp	Newport	777-2571
Bernard Teels		782-2544
Albert Dupuis	Rivière au Renard	269-7701
Sylvain Samuel	Rivière au Renard	269-7701
Serge Hautecoeur	Ste.-Thérèse de Gaspé	385-2768
Jean-Marc Legault	Rivière au Renard	269-5488
Albert Diotte	Grande-Rivière	385-2635
Michel Alain	Newport Centre	777-2347
Donald Syvrais	Newport	777-2878
Marcel Roussy	Ste.-Thérèse	385-2079
Roland Lebreux	Grande-Rivière	385-3145
Edmond-Guy Grenier	Newport	777-2660
Réjean Dupuy	Pabos	689-6275
Gilles Dupuy	Pabos	689-2430
Marcel Boudreau	MPO, Québec	648-4946
Christian Huard	St.-Godefroi	752-2851
Normand Duguay	Pabos	689-2869
Bruno Duguay	Pabos	689-4176
Ronald Lavallée	CBC News - Gaspé Harbour	
Martine Painchaud	Radio Canada - Gaspé Harbour	
Bruno Vibert	Newport	777-2974
Gérald Allain	Gascons	396-2958
Gilles Meunier	Newport	777-2551

Gilles Gagné	Carleton	364-6369
René Bouchard	Gaspé	368-5467
Pierrot Duguay	Newport	777-2445
Denis Duguay	Newport	777-2021
Levy Reid	Grande-Rivière	385-3933
Claude Stevens	Grande-Rivière	385-2462
Christian Daraiche	Pabos	
Daniel Daraiche	Pabos	689-6981
Paul-Denis Carron	St.-Yvon	395-2504
Marcel Donahue	Percé	782-2384
Michel Syrois	Newport Centre	777-2347
Manon Dumas	Gaspé	368-5559
Gilles R. Duguay	Pabos	689-2430
Sylvio Cloutier	Percé	782-2975
Sylvio Coulombe	Gaspé	368-4707
Claude Rolencin		892-5430
Jean Lacasse		892-5539
Benoit Boulez	Gaspé	368-5693
Alcide Morlay	Forillon	892-5689
Laurent Millot	Centre Spécialisé des Pêches	385-2241
Jean-Marie Duguay	Newport	777-2970
Robert Langlois		269-3386
Benoit Reeves	Pêcherie Gaspésie	269-3331
Rodrigue Langlois	Anse-au-Griffon	892-5117
Robert Mercier	Newport	777-2241
Gilles G. Duguay	Pabos	689-2859
Ghislain Chouinard	DFO, Moncton	(506) 851-6220
Mark Hanson	DFO, Moncton	(506) 851-2047
Tom Hurlbut	DFO, Moncton	(506) 851-6216
Rod Morin	DFO, Moncton	(506) 851-2073
Gloria Nielsen	DFO, Moncton	(506) 851-2035
Alan Sinclair	DFO, Moncton	(506) 851-2721

9.2 Groundfish Stocks November 16, 1994 Centre Marin, Shippagan, N.B.

Personnel from the Dept. of Fisheries and Oceans, Science Branch, Gulf Region presented an overview of the data on the groundfish stocks of the southern Gulf of St. Lawrence collected during 1994 including a summary of catches and the preliminary results of the September Groundfish survey. The objective of the meeting was to obtain the views of fishermen and fishing industry on the status of the various groundfish stocks. These observations and comments will be considered in the preparation of the assessments of the status of these stocks. The following represents a summary of the main points made by participants during the meeting.

Environmental conditions

- Two fishers that were present noted that water temperatures at approximately 100 fathoms were colder than normal in 1993. They noted a decline in water temperatures since 1990. Fish appeared to be concentrated in deeper water.

- Currents were stronger in the Laurentian Channel during 1993 and there was generally more wind than previous years.

- One fisher who fishes redfish noted less "bait" in the water in recent years.

Stock status

Cod

- Concerning assessments, it was questioned whether the cod resource could be adequately assessed without a fishery.

- Several questions were raised about the adequacy of research surveys.

  - Is the fishing expertise onboard research vessels adequate? The crews of the research vessel include several experienced fishers.

  - Is the fishing gear (trawl) appropriate and up to date ? The experimental trawl currently used is a modified Western IIA trawl. It is important to use the same trawl in the annual surveys to ensure that the abundance estimates are consistent from year to year. When the trawl was changed from a Yankee 36 to the Western IIA in 1985, a comparative fishing experiment was conducted to determine if there was a difference in fishing power.

  - Is Scanmar used on the trawls? Wing spread and headline height sensors are currently used.

  - Is the annual survey conducted at the best time of year? Cod are more dispersed in September than in other times of the year when they are migrating or spawning. If the survey would be conducted in the spring or the fall, during the migration, there would be a danger of counting fish twice or missing them altogether depending on the timing of the migration. The survey estimates are less variable when the fish are more evenly dispersed.

- Several fishers felt that cod migrated earlier than usual and that recent

surveys may miss a part of the stock, resulting in underestimated biomass of cod in 4T. One fisherman requested improved surveys, including the sentinel fishery, in order to avoid future errors in estimating abundance.

- Several observations were made on the abundance of cod. In 1994, the lastridge rope study conducted near Chéticamp produced much larger catches of cod than in 1993. There was a two-week difference in the dates of the study over the two years due to differences in the timing of the cod migration. It was noted that cod catches by jigger in 1994 were more abundant than a similar effort made in 1985 and 1986. The cod were also larger in jigger catches in 1994. Several fishers felt that the abundance of small cod (14-17 inches) had increased; large catches of 6-10 inch cod were made in the sentinel fishery in southwestern 4T. One fisherman, Pierre Haché, recorded poorer cod abundance in 1994 in the southern Laurentian Channel where he fishes. In general, it appeared that fishers who had fished over broad areas in 1994 felt that cod was less abundant than in the past.

- Concerning regulations, it was felt that a better control is necessary of illegal fishing for cod. Some felt that cod catches could be two to three times the reported levels. One person reported that cod earned $0.70/lb on the black market during the spring of 1994. Estimated incidental catches of cod, made by onboard observers, should be applied to nearby fishing vessels. Several fishers considered that this would provide more accurate estimates of the overall level of incidental capture of cod. It was also noted that at times fishing vessels will avoid areas with observer coverage.

- In the past, commercial fisheries concentrated on schools of migrating cod and stayed with them as they migrated from the Gulf. The current reduced biomass of cod and the small effort of the sentinel fishery may lead to inaccurate estimates of cod abundance. Fishers stressed the need for an expanded sentinel fishery throughout the southern Gulf, east and west.

American plaice

- Some fishers noted that the overall abundance of plaice was low in 1994.

- Pierre Haché reported that throughout northwestern 4T, snow crab has displaced plaice. He has noted this problem since 1992; however, it became acute in 1994.

Winter flounder

- The meeting was not attended by winter flounder fishers.

- It was noted that good winter flounder catches were made east of Miscou Island in 1994.

- Concern was expressed over recent regulations on the by-catch of winter flounder in the smelt trap fishery.

Witch flounder

- Two fishers who fish witch indicated that abundance was down.

White hake

- White hake is not fished a lot and it was described by fishers as a by-catch fishery.

- One fisherman described hake as a once abundant resource that has declined for reasons that are not clearly understood. He pleaded for an increased research effort on this resource.

Dogfish

- Some fishers felt that there were more dogfish than indicated by the research survey.

- It was noted that a large concentration of dogfish occurred in the Bay of Fundy during the 1980s. Has this concentration moved into the Gulf of St. Lawrence?

- One fisherman noted that dogfish were abundant in the Gulf in 1958-1959.

Participants

Caroline Moore	Bas-Caraquet	727-2456
Jacqueline Paulin	Shippagan	336-8318
Edmond Drysdale	Shédiac	532-9162
Jimmy Ward	Shippagan	336-4931
Télex Martin	St.-Louis	876-2175
Peter Noël	Shippagan	336-4180
Mathurin Noël	Shippagan	336-8744
Marc Michon	Bas-Caraquet	727-4671
Gino Haché	Caraquet	727-2823
Yvon Gauvin	Petit Lamèque	344-2351
André Jean	Pointe Canot	344-5650
Louis Jean	Pointe Canot	344-5167
Conrad Noël		
Paul Haché	Caraquet	727-6617
Maurice Haché	Caraquet	727-5595
Calixte Chiasson	Lamèque	344-8108
Paul Noël	Lamèque	344-8045
Denis Robichaud	Shippagan	336-8997
Félix Paulin	Shippagan	344-5160
Alvain Chiasson		727-4224
Raymond Mallet		727-5491
Claude LeBouthillier		726-2400
Robert Haché	Shippagan	336-4722
Florence Albert	DFO - Tracadie-Sheila	395-7740
Ghislain Chouinard	DFO, Moncton	851-6220
Mark Hanson	DFO, Moncton	851-2047
Tom Hurlbut	DFO, Moncton	851-6216
Rod Morin	DFO, Moncton	851-2073

9.3 Groundfish Stocks November 23, 1994 Charlottetown, P.E.I.

Personnel from the Dept. of Fisheries and Oceans, Science Branch, Gulf Region presented an overview of the data on the groundfish stocks of the southern Gulf of St. Lawrence collected during 1994 including a summary of catches and the preliminary results of the September Groundfish survey. The objective of the meeting was to obtain the views of fishermen and the fishing industry on the status of the various groundfish stocks. These observations and comments will be considered in the preparation of the assessments of the status of these stocks. The following represents a summary of the main points made by participants during the meeting.

Environment

- During September, surface temperatures of 52-56° F were observed at the east end of P.E.I., which were warmer than those observed in 1993.
- Winds were predominately southwest but light. This resulted in little mixing of warm and cold water.

The fishery

- Description of fishery did not match well with view of fishermen. Consensus seemed to be that sizeable landings were missing for all species at the East end of PEI, in particular for fixed gear. The information presented was from observer data and it was noted that the coverage by observers was not very high.
- Common comment was that large amounts of landings were missing (esp. cod by mobile gear) because no one was there to record the landings and there were no observers deployed out of PEI as an independent check.
- Thought recreational fishery caught a lot more than reported.
- Common comment: All fishermen should fill out logbooks - no exemptions.
- A small number commented: Logbooks are useless because most fishermen just fill them out to suit their own requirements, i.e., they don't record small fish, dumping, high grading, or quota overruns.
- Comment: there were no records of dogfish landings off of Miminegash (they were landing about 125,000 lbs/d) or Tignish.
- Many hake landings from East PEI were missing.
- the landings of winter flounder from Fisherman's Bank and west end of Strait were missing.
- By-catch restrictions for cod in Hake fishery were too restrictive. i.e. 3-5 July 1994 fixed gear fishery off east PEI landed 40,000 lbs of cod vs 4,800 lbs of hake.

Cod

- Common comment: cod were far more abundant in shallows near East end of PEI (Souris) than ever seen before and thought the survey had underestimated this fact.

- Thought many more cod were in shallower water (< 15 fathoms), and present all year, than ever seen before, e.g., many more cod in St. George Bay in early June than in past and this continued up to Cheticamp (1 May to mid-June).

- Concern expressed over uncertainty as to why *Alfred Needler* and *Lady Hammond* caught different amounts of fish when fishing side-by-side.

- One fisherman thought we should be altering tow speed to correct for water depth and amount of warp out.

- Many would like to see study where fishing boat(s) conducted side-by-side survey with the research vessel to get idea of relative catch rates.

- Occurrence of cod in lobster traps was among highest ever seen and were present virtually all season. The majority were thought to be Atlantic cod rather than Greenland cod. Want to see sampling of cod in traps and shallow water done all year round to assess how much lobster is eaten by cod.

- The cod seen in lobster traps were small and very thin during May-June.

- Fishermen would like to see a more comprehensive study of cod feeding.

Seals

- Participants wanted to know what sizes of cod are eaten by seals, impact of seal predation on fish in shallows of Northumberland Strait (seals stay around all year now), and were not pleased that seal scientist was not present at the meeting.

- Want a meeting to permit fishermen to mount sampling program for seal stomachs in the southern Gulf.

- Want to know effect of seal predation on 4T cod recruitment.

- The fishermen want a reduction of the seal herds and that the abundance be controlled as recommended by the FRCC.

Plaice

- There was more effort in 1994 than in other years and it was displaced to East.

- Some participants questioned whether the species are being separated properly in the landings.

- Plaice abundance is lower than was seen during 1970s.

Winter flounder

- It was reported that many of the plaice landings were really flounder and that fishery officers and some fishermen cannot tell them apart.

- A big reduction in winter flounder catches off East PEI but catches are cleaner because larger mesh are used.

- Many felt that the main survey is inadequate for winter flounder index, could the juvenile cod survey be modified to also cover winter flounder, at least in west?

Hake

- Some stated that the decline in abundance in the western Gulf was real but the overall consensus was that East P.E.I. hake is in good shape.
- Some noted hake were no longer in areas where cod were found in 1994.
- Some felt it was difficult to comment on abundance due to large numbers of closures.
- There was a big reduction in mobile gear catch off East PEI (Souris) but the hake were plentiful in the shallow warm water near the end of Northumberland Strait.
- Dogfish were driving fishermen off of hake grounds.
- Many small hake are caught in silverside (October onwards) and eel fisheries (September onwards) in PEI estuaries.
- Participants would like abundance expressed in terms of stock units not whole Gulf, what is DFO doing to resolve stock identity problem?
- One commented that mesh changes resulted in trawl fisheries having less by-catch than longline fisheries for hake and that longliners use of #9 & 10 hook and catch many small fish as a result.

Dogfish

- Some feel dogfish have driven hake and perhaps plaice out of the western Gulf
- Some feel dogfish are being wiped out in N.S. waters,and that the last time dogfish collapsed because of massive fishing in US waters.
- Many dogfish were inshore (herring nets).
- There were lots of dogfish along north side (70 to 130 feet) during Sept/Oct.

Redfish

- One participant wondered why were there differences in abundance trends betweeen Unit 1 and Unit 2 redfish.
- Could the Unit 1 fish be elsewhere, i.e., in Unit 2?

Sentinel fishery

- Fishermen were concerned that NB fishermen dominated the program in 1994.
- PEI fishermen were not consulted and felt disadvantaged (projects unfairly awarded).
- There must be multiple gear types used in the program.
- One commented that it should continue throughout the open fishing period.

Participants

Franklin Pitre	Tignish	882-2039
Alvin Pitre	Tignish	882-3088
Gary Pitre	Alberton	853-3192
Cyril Gallant	Souris	687-3100
Norman Pitre	North Rustico	963-2525
Frank Hennessey	Souris	687-3256
James MacDonald	Souris	687-3210
Roy Drake	Morell	961-2330
Linus Watts	Grand Tracadie	672-1246
Fred Morrison	Covehead	629-1437
David Cheverie	Naufrage	687-3476
Wayne F. Anderson	St. Peter's Bay	961-2261
Paul Anderson	Souris	687-3494
Fred Pigott		676-2987
John H. Banks	Souris	583-3326
Gérald Trembley	Miminegash	882-2282
Allan J. MacDonald		675-2119
Jerry Sutherland	Souris	357-2345
Patrick Radford	Alberton	853-2044
Bernard Dixon	Souris	687-2841
Roy Gavin	Tignish	882-2678
Michael MacDonald	East Point	357-2269
Kevin Robertson	Souris	357-2606
Cyrus Bernard Jr.	Skinners Pond	882-2569
Preston Hogan	Tignish	852-3417
William MacKay	Beach Point	962-2971
Joseph Clow	Grand Tracadie	569-4695
Dave Gillis	PEI DFA Charlottetown	368-4880
Doug Cameron	HAB, Charlottetown	894-3137
Jim Jenkins	DFO, Charlottetown	566-7815
Ray St. John	DFO, Montague	838-2422
Ghislain Chouinard	DFO, Moncton	851-6220
Mark Hanson	DFO, Moncton	851-2047
Tom Hurlbut	DFO, Moncton	851-6216
Rod Morin	DFO, Moncton	851-2073
+ 2-3 reporters		

9.4 Groundfish Stocks November 24, 1994 Chéticamp, N.S.

Personnel from the Dept. of Fisheries and Oceans, Science Branch, Gulf Region presented an overview of the data on the groundfish stocks of the southern Gulf of St. Lawrence collected during 1994 including a summary of catches and the preliminary results of the September Groundfish survey. The objective of the meeting was to obtain the views of fishermen and the fishing industry on the status of the various groundfish stocks. These observations and comments will be considered in the preparation of the assessments of the status of these stocks. The following represents a summary of the main points made by participants during the meeting.

General Comments/Opening Words

- No requests for additional agenda items.

Environmental Conditions

- Surface temperatures were higher during the summer and fall of 1994 (by 2-3°) in the Northumberland Strait.
- Water temperatures are not usually measured by fishermen but there have been no obvious changes during the past 10-15 years (There have been obvious changes in the timing of cod and flounder catches though - earlier than before).
- Ice conditions were better this spring (94) - no or fewer pressure ridges
- Spring and summer of 94 were "calmer" than in previous 3 years but there were strong westerly winds in Oct. and Nov.
- The ice departed very suddenly in the spring of 94.
- There was more wind in the fall of 94 than in fall of 93.
- Feel there is a relationship between parasite infestation in groundfish and water temperatures (with heavier parasite loads in spring during the migration into the Gulf and reduced loads in the fall).

Stocks Status

▶ *Commercial Fisheries (Fleet Distribution) in 1994*

Mobile

- Witch directed fishing effort off the tip of Cape Breton (outer edge of 4T9) not shown on the mobile gear figure.
- There were significant catches of cod in the redfish fishery (mobile) along the Laurentian Channel How much hake was caught in this fishery? (estimate 10%).
- Hake directed fishing effort off the Lismore-Cape George area not shown on the figure of mobile gear catches.
- Feel there was a lack of observer coverage in the shrimp fishery off the Gaspé coast .
- Shrimpers used to go into 4R late in the season to fish their by-catch allocation of cod - This was done in 93 but not in 94.

Fixed

- Hake and halibut directed fishing off St. Paul's Island near the 4T boundary (spring) not shown on the fixed gear figure.

- Why does the figure of fixed gear catches show cod directed fishing effort off Tignish PEI? There was a high catch of cod during the fixed gear fisheries in July 1994 off northern PEI. Because cod was the main species caught, this effort was designated as cod directed.

- The figure of fixed gear catches should have cod directed effort in the Fisherman's Bank area.

- The figure of fixed gear catches should have flounder directed effort ("tangle" nets) off New Brunswick.

- Ninety percent of the hake directed fishing effort was in the Northumberland Strait in 94.

- Hake directed fishing effort (both fixed and mobile) was reduced due to cod by-catch restrictions -Therefore catch data must not be used to judge stock abundance What information did the FRCC use when they issued their latest report?

- Hake catches were poor in the Northumberland Strait due to lack of season.

- By-catch of white hake should be limited as is the case for other groundfish species.

- How good are the data on which the maps of commercial catches are based? (Reference to DFO Scotia-Fundy Region report that questions the reliability of logbook data).

- Many participants were sceptical about the quality of logbook data.

Southern Gulf Cod

- Jigging for cod was good in 1994.

- What was the by-catch of cod in the redfish fisheries in 4Vn and 4T? Many participants indicated that the by-catch of cod in these fisheries was far greater than quota reports indicate (Suggest possibly 10X greater) What was the level of observer coverage in this fishery?

- By-catches of cod exceeding 5% were allowed after Nov. 15/93 in the 4RS and 3Pn redfish fisheries - By-catch levels were as high as 50% in the fall of 1993 (landed in North Sydney, Canso, Glace Bay and Chéticamp).

- More restrictions are necessary in the recreational fishery (More than 10 cod/person were taken this year - there is a "black market" for cod in this fishery).

- Why conduct the groundfish survey in September? It was thought that it was the worst time possible. Scientists indicated that the survey is conducted at that time because cod are dispersed and are not in their migration in or out of the Gulf. If the survey was being conducted when cod are migrating, fish could be counted twice or missed altogether depending on the timing of the migration.

- Wind affects the concentration distribution of groundfish.

- Science Branch is not getting a "true picture" of the cod stock with the *Alfred Needler* survey and bottom trawl gear.

- After the closure of the mobile fishery in the early 1970's the cod stock recovered within 5 years.

- The abundance pattern for cod does not reflect the perception of many fishers (1. There were more cod in the Gulf in 1994 than last year 2. There were more cod in the 4Vn test fishery 3. Cod abundance in the western Gulf has been low for the past 15 years).

- Agree that cod abundance was high in the mid 1980's and low in the early 1970's.

- Disagree with the presentation on cod abundance for the late 1980's - Feel that it was far lower from 1989 to 1991 or 1992.

- What proportion of Science Branch's research on 4T groundfish is paid for by industry? None of it.

- There were far more cod in the Chéticamp area in 1994 than recently (1992 and 1993)

American Plaice

- There has been mis-reporting of plaice/flounder catches by fishers in the Magdalen Islands.

- Most of the flatfish that are caught will survive if released within 20 minutes.

- Unable to comment on the abundance of plaice in the late 1980's and early 1990s.

- There were more plaice in 1994 than in previous years.

- Many vessels (mobile) that fish in the Northumberland Strait have been using 145 mm square mesh since 1992.

- There were more plaice in the Northumberland Strait this year.

- Plaice were very abundant in the early 1980s off Cape Breton then abundance declined. Recently. plaice are more abundant (as in the early 1980's).

- The plaice migration was about one week earlier than usual this year.

Winter Flounder

- Flounder were more abundant and larger in the Northumberland Strait this year (ie. Lismore area).

- Good catches of flounder in St. Georges Bay this year (1994).

- Flounder were more abundant locally this year than in 1993.

- The last place flounders are caught in the fall (Nov.) is in deep water.

- There was a large concentration of flounder (12 inches long and larger) close to the Magdalen Is. (70-80 fathoms) in 1991.

Witch

- A participant requested a survey of witch distribution and abundance.
- There has been a decline in the catch of witch by one gear sector over the past two years, possibly due to new effort directed at witch by the mid-shore fleet.
- Participants were uncertain about changes in the abundance of witch in 1994 because of cod by-catch restrictions and closures.
- The witch fishery was relatively stable before 1992.
- There are local (resident) witch stocks.
- Witch were possibly more abundant this year (large fall "run").
- Fishing and catch rates for witch were affected by closures in 1994

White Hake

- There was an abundance of small hake in St. Georges Bay in 1992 and 1993
- The hake fishery was very good off St. George's Bay in 1994, fishers have not seen a decline in abundance.
- Very little hake directed fishing east of Sight Point this year because of closures (cod).
- Hake fishing should be controlled in 4Vn during winter.
- Mobile vessels are targeting hake in 4Vn now (winter and early spring) - It was a fixed gear (longline) fishery in the past
- There was more hake in 3Pn in 1994 during Sept. and Oct. (coincides with time that hake start migration out of Gulf).
- Scallop draggers from Pictou area reported catching juvenile hake in their drags in the fall of 1994.
- Lobster fishers reported catching more hake in their traps this year (as high as 200-300/day).
- Disagree with results of Groundfish Index Fisher Program (Not true that hake were smaller and scarcer)
- Recommend an inquiry into disagreements re. status of cod and hake.
- Landing statistics need to be improved.
- Hake caught in eastern end of Northumberland Strait were in better condition (fatter) this fall (feeding on herring).
- Catch rate of hake in commercial gears was higher in 1994 (eastern 4T).
- Opinions of fishers expressed in 1994 Stock Status Report (re. hake) are not scientific - Recommend a survey of opinions from active fishers.
- C & P officers are not informed about regulations.

Spiny Dogfish

- Dogfish were late arriving in Gulf and are still present.

- Dogfish appeared in the commercial fishery the same year that they showed up in the groundfish survey (ie. 1984).

Participants

Ralph MacDonald	Port Hood	787-2764
Bernie Batherson	Port Hood	787-2105
John MacInnes	Port Hood	787-3221
Michael MacDonald	Port Hood	787-2764
Sandy Beaton	Mabou	945-2821
John Boyd	Antigonish	863-2080
Jules Chiasson	Chéticamp	224-3523
A.J. Beaton	Mabou Hax	945-2091
Lionel Chiasson	Chéticamp	224-3642
Bob Watts	Port Hood	787-2082
John P. Rankin	Mabou Mines	945-2860
Scott Cameron	Port Hood	787-2801
Robert Courtney	Dingwall	383-2142
Donnie MacAskill	Aulds Cove	747-3280
Max Keeping	Aulds Cove	747-2920
Stephen Webb	Havre Boucher	234-2741
Robert MacDonald	Port Hood	787-3198
Allan Adams	Antigonish	863-3766
Charlie Boyd	Antigonish	863-3627
Wayne Boyd	Antigonish	863-3627
Clifford Aucoin	Chéticamp	224-3589
Simon Muise	Chéticamp	224-2740
Cyril Burns	Chéticamp	224-2876
Gary McKay	St. Joseph du Moine	224-3774
Boyd MacEachern	Antigonish	863-2089
David Horne	Antigonish	863-6517
Andrew Rankin	Mabou	949-2709
John Buchanan	Dingwall	383-2498
Trevor MacInnis	Port Hood	945-2263
Kenneth Fraser	Pleasant Bay	224-3441

Leopold Chiasson	St. Joseph du Moine	224-2817
Dennis MacLean	Mabou	945-2373
Jackie Johnson	Scotsburn	485-8133
Ron Heighton	River John	351-2741
Ronnie Boyd	Antigonish	863-6961
Percy J. Hayne	Merigomish	926-2229
Joe Boudreau	Antigonish	863-6216
Archie MacKenzie	Antigonish	863-4888
Francis Boyd	Antigonish	863-8037
Michael Boyd	Antigonish	863-0951
Robert Boyd	Antigonish	863-6716
Arthur LeBlanc	Chéticamp	224-2017
Charles A. Benoit	Antigonish	386-2199
Danny C. Boyd	Antigonish	863-1108
Hector Mckay	Bay St. Lawrence	383-2849
Billy Bishop	Antigonish	863-0298
David Baxter	Antigonish	863-4806
Philip George	DFO,Antigonish	863-5670
John Hanlon	DFO, Antigonish	863-5670
Adrian Touesnard	DFO, Chéticamp	224-2017
Ghislain Chouinard	DFO, Moncton	(506) 851-6220
Mark Hanson	DFO, Moncton	(506) 851-2047
Tom Hurlbut	DFO, Moncton	(506) 851-6216
Rod Morin	DFO, Moncton	(506) 851-2073

9.5 Groundfish Stocks
November 28, 1994
Cap-aux-Meules, Magdalen Islands

Personnel from the Dept. of Fisheries and Oceans, Science Branch, Gulf Region presented an overview of the data on the groundfish stocks of the southern Gulf of St. Lawrence collected during 1994 including a summary of catches and the preliminary results of the September Groundfish survey. The objective of the meeting was to obtain the views of fishermen and the fishing industry on the status of the various groundfish stocks. These observations and comments will be considered in the preparation of the assessment of the status of these stocks. The following represents a summary of the main points made by participants during the meeting.

Environment

- 1994 was warmer than recent years.
- Ice left the area around the Magdalen Islands earlier than is recent years, near the end of March.
- It was generally calmer than usual.
- There was a higher accumulation of algae on lobster traps possibly indicating warmer water.
- It was suggested that regular temperature observations could be obtained from DFO patrol vessels operating in the area.

Commercial Fisheries

- Maps of 1994 fishery locations were presented.
- Several participants questioned reported redfish and cod mobile gear fisheries close to the Magdalen Islands and suggested that these fisheries may have occurred elsewhere.
- They indicated that there was fixed gear fishing for halibut around the Islands and more plaice fishing west and east of the Islands than indicated on the maps.
- It was noted that catches of plaice were low north of the Magdalen in 1994, but that good catches were made toward the Cape Breton coast.
- Catches of most groundfish species were low and it was suggested that the fall migration occurred earlier than normal.
- Redfish abundance appears to be down.

Cod

- Participants noted that it was difficult to judge the abundance of cod in 1994 because there was no directed fishing.
- All participants agreed that cod abundance had declined from the mid 1980's, some felt that abundance in 1994 was still very low while others felt that there had been an increase.

- Several noted more small cod (pre-recruit size) in 1994 than 1993, particularly east of the Islands.

- One participant stated that large by-catches of cod occur in the redfish fishery deeper than 200 fathoms in December.

Plaice

- Fixed gear fishers noted a reduction in abundance of plaice south of the Islands and around Deadman's Island. Some also noted smaller sized plaice.

- Mobile gear fishers noted an increase in abundance.

Winter Flounder

- In general, a decline in the abundance of winter flounder was noted.

Yellowtail

- There seemed to have been a large change in abundance and distribution. Yellowtail are found southeast of Entry Island and are of lower abundance than in the mid-1980's.

White Hake

- There was general agreement that the abundance of hake has declined.

- There is a lot less large hake and more small ones.

- Hake are taken as by-catch in the redfish fishery in June-August along the Channel edge north of the Magdalens.

Dogfish

- There were large concentrations of dogfish around the Magdalens in the mid 1980's. The highest abundance was in 1985-86.

- Abundance has declined since 1990.

- Dogfish may be found in the area until early November.

- Many dogfish caught in gillnets have hook scars in their mouths.

Haddock

- There are fewer haddock than in the mid-1980's.

Halibut

- There are fewer halibut but they are larger.

Squid

- Several participants noted an above normal abundance of squid at depths > 100 fathoms.

Seals

- All agreed that both Harp and Grey seal abundance was very high and that seal predation was affecting fish abundance.

- It was noted that Harp seals remained in the area longer in recent years.

- Fish were very scarce around Deadman's Island where Grey seals haul out.

- Many fishers are willing to collect seals for stomach content analysis.

Sentinel Fishery

- It was suggested that a longline sentinel fishery be established, using #12 hooks and standard fishing gear.

Participants

Alain Marcoux	Ass. pêcheurs prof. Iles	
Réjean Richard	MAPAQ	986-2098
Hélène Fouleux	CFIM (Radio)	986-5233
Marcel Cormier	Pêcheur RPPIM	986-4048
Georges Turbide	Pêcheur RPPIM	969-2752
Bruno Bourque	Pêcheur RPPIM	986-5355
Albert Longuepé	Pêcheur RPPIM	986-4276
Jérôme Landry	Pêcheur RPPIM	
Emmanuelle Begioneau	Le Radar Inc. (Journal)	
Archille Hubert	Le Radar Inc. (Journal)	
Pierre Arseneau	Pêcheur RPPIM	
Alton Dickson	Pêcheur RPPIM	
Georges Bourque	Pêcheur RPPIM	
Ghyslain Cyr	Pêcheur APPIM	
Léo Leblanc	Pêcheur APPIM	
Jean-Marc Lapierre	Pêcheur APPIM	937-2342
Ernest Lebel	Pêcheur APPIM	937-5319
Guy Vigneau	Pêcheur APPIM	937-2517
Raynald Lapierre	Pêcheur APPIM	937-2724
Martin Lapierre	Pêcheur APPIM	
Jeffrey Thorne	Pêcheur APPIM	937-5792
Claude Nadeau	Pêcheur APPIM	986-4197
Pierre Chevrier	Pêcheur APPIM	
Jean-Charles Lapierre	Pêcheur APPIM	937-5719
Paul-Eugène Hubert	Pêcheur APPIM	
Claude Vigneau	Pêcheur APPIM	
Jérémie Lapierre	Pêcheur APPIM	
Jean-Charles Vigneau	Pêcheur APPIM	
Fernand Renaud	Pêcheur APPIM	
Johanne Bourque	RESMAR	
Carole Turbide	MPO - Iles-de-la-Madeleine	
Albert Cyr	MPO - Iles-de-la-Madeleine	
Gérald Poirier	MPO - Iles-de-la-Madeleine	
Gilles Poirier	MPO - Iles-de-la-Madeleine	
Roger Simon	MPO - Iles-de-la-Madeleine	
Carol Boudreau	MPO - Iles-de-la-Madeleine	
Jean-Guy Thériault	MPO - Iles-de-la-Madeleine	
Ghislain Chouinard	MPO, Moncton	851-6220
Tom Hurlbut	MPO, Moncton	851-6216
Rod Morin	MPO, Moncton	851-2073
Alan Sinclair	MPO, Moncton	851-2721