Collected Stock Status Reports for Marine Resources Assessed by the Newfoundland Region in 1996

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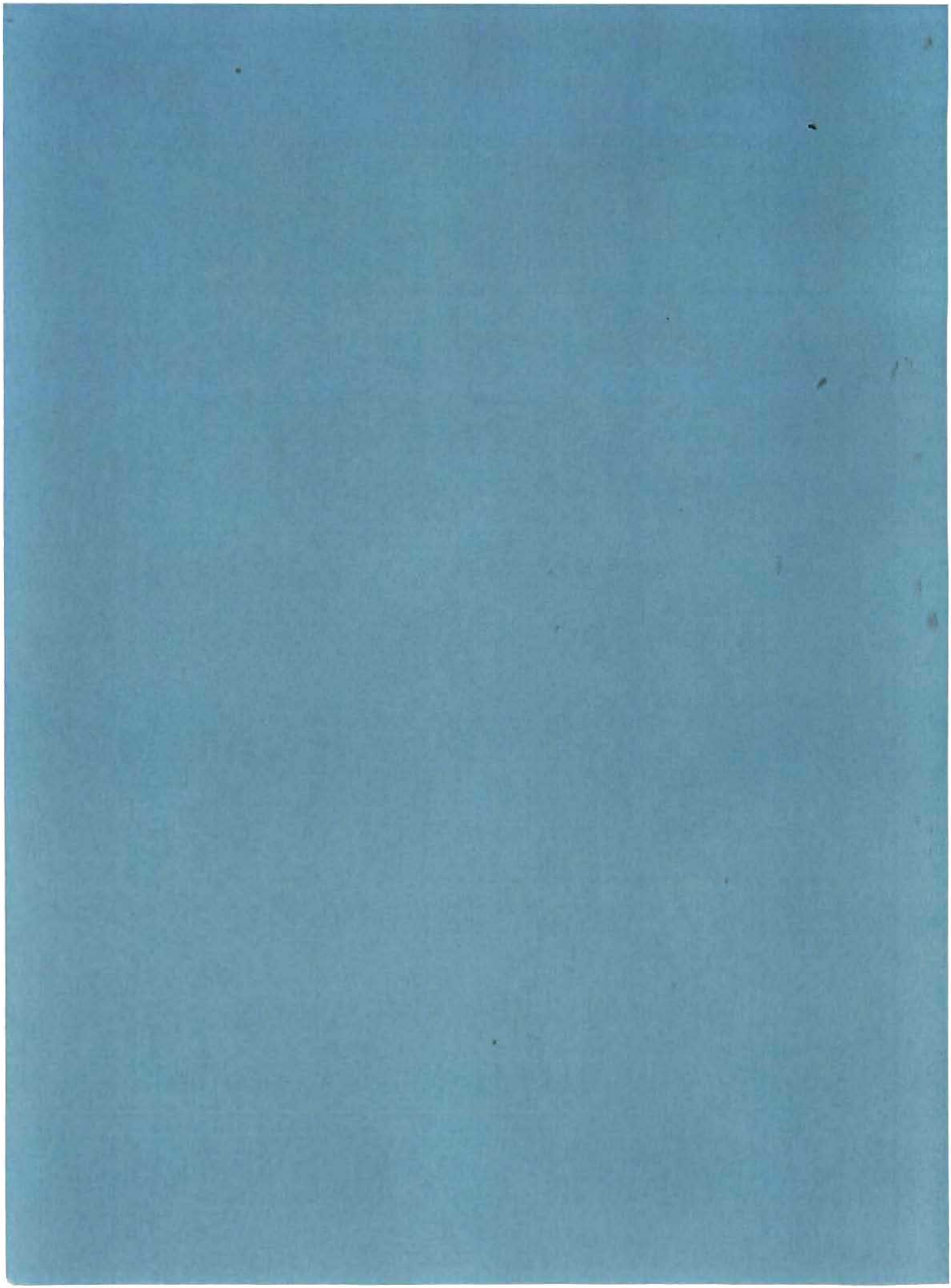

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COLLECTED STOCK STATUS REPORTS FOR MARINE RESOURCES ASSESSED BY THE NEWFOUNDLAND REGION IN 1996

by

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ABSTRACT

Perry, G. (ed.). 1996. Collected Stock Status Reports for Marine Resources Assessed by the Newfoundland Region in 1996. Can. Man. Rep. Fish. Aquat. Sci. 2398: vii + 77p.

The present document is a compilation of twenty-three stock status reports that describe important results and main conclusions pertaining to the conservation and management of twenty-two stocks of groundfish, anadromous fish, pelagic fish, shellfish, and marine mammal resources in the Northwest Atlantic, environmental conditions, and an overview of the regional stock assessment process in the Newfoundland Region DFO in 1996. These reports provide biological advice to the Fisheries Resource Conservation Council, in the case of groundfish, and to fisheries managers which allows them to formulate advice on conservation and to develop management plans for these resources.

RÉSUMÉ

Perry, G. (ed.). 1996. Collected Stock Status Reports for Marine Resources Assessed by the Newfoundland Region in 1996. Can. Man. Rep. Fish. Aquat. Sci. 2398: vii +77p.

Le présent document rassemble vingt-trois rapports qui décrivent les résultats importants et les principales conclusions sur l'état de vingt-deux stocks du poissons de fond, poissons pélagiques, poissons anadromes, invertébrés, et mammifères de l' Atlantique nord-ouest, ainsi que sur les conditions environnmentales de l'Atlantique nord-ouest en 1995, et décrivent le processus régional d'évaluation. Ces rapports représentent la contribution biologique permettant au Consil de Conservation des Ressources Halieutiques et aux gestionnaires des pêches de fournir des avis sur la conservation et d'établir des plans de gestion de ces ressources exploitées.

Forward

The objective of the present document is to provide a compilation of stock status reports for marine resources assessed in the Newfoundland Region of DFO in 1996 and to provide an overview of the regional stock assessment/review process in 1996. The Science Branch of Newfoundland Region has responsibility for providing advice on the status of various groundfish, pelagic fish, anadromous fish, invertebrates, and marine mammal stocks extending from the Davis Strait south to the Cabot Strait and Tail of the Grand Bank and eastward to the Flemish Cap in the Northwest Atlantic. The stock status reports contained in this manuscript have already been released and distributed to the fishing industry and other client groups.

In the Newfoundland Region, regional assessment/review committees for groundfish, shellfish, and pelagic fish were called to review the three species or species groups following a timetable to meet client, Fisheries Resource Conservation Council, and fisheries mangers requirements. Reviews were preceded by a general review of environmental and ecological issues and included client consultations to include information from recreational and commercial fisheries. Assessment/Review teams were comprised of DFO and university researchers, industry representatives, DFO Fisheries Management Branch personnel, fishermen, and provincial government representatives. The level of participation varied significantly across the various regional assessment committees. Stock Status Reports were produced for each of the species/stocks reviewed and are published in the DFO Atlantic Fisheries Stock Status Report Series. Research documents are referenced in the Stock Status Reports and provide the technical details and basis for the respective assessment or review and are published in the DFO Atlantic Research Document Series. Proceedings of assessment/review meetings were prepared and appear in the DFO Atlantic Fisheries Proceedings or in the Canadian Manuscript Report of Fisheries and Aquatic Sciences series. These proceedings provide a record of the discussion and debate on the assessments and include summaries of tabled working papers, meeting participants, and research recommendations. Species and stocks assessed or reviewed in 1996 are summarized in Table 1.

Species	Stock	NAFO SCR Doc. #	Dates
Cod	2J3KL 3NO	96/62 96/80	Jun 5 - 19 Jun 5 - 19
American plaice	3LNO	96/75	Jun 5 - 19
Witch flounder	2J3KL 3NO	96/105 96/70	Sept 7 - 13 Jun 5 - 19
Yellowtail flounder	3LNO	96/74	Jun 5 - 19
Greenland halibut	Subarea 2 + 3KLMNNO	96/73	Jun 5 - 19
Shrimp	Subarea 0 + 1 3M	96/106 96/102	Nov Sept 7 - 13
Redfish	3LN	96/76	Jun 5 - 19
Roundnose/ Roughhead grenadier	Subarea 2 + 3	96/69	Jun 5 - 19

In addition to the regional stock assessment process, scientific information was also presented on a zonal or national basis, or at the Scientific Council of NAFO. A number of species and stocks are assessed regionally and reviewed zonally across the Atlantic zone.
The status of Atlantic salmon, Arctic char, and trout were assessed in Newfoundland Region but was compiled and published with an Atlantic Zone overview and is available in "Report on the Status of Atlantic Salmon Stocks in Eastern Canada in 1995," DFO Atlantic Fisheries Stock Status Report 96/80. Some redfish stocks were assessed zonally and the report on redfish is also available in "Status of Redfish Stocks in the Northwest Atlantic: Redfish in Units 1, 2, and 3, and in Division 30, " DFO Atlantic Fisheries Stock Status Report 96/88.

A number of stocks are also reviewed or assessed by the Scientific Council of NAFO. Those stocks and species are identified in Table 2.

Committee	Species	Stock	Timing	SSR #	Proceedings
Regional Pelagics Assessment Committee					
	Capelin	Subarea 2 + 3KL	Mar 11-14, May 3	96/23	
	Herring	East and SE coast Newfoundland	Oct 3, 10, 25, 29	Draft	
Regional Shellfish Assessment Committee					DFO Atlantic Fisheries Proceedings 96/5
	Snow crab	all Snow Crab	Feb 22 - Mar 1	96/15	
	Iceland scallops	4R	Apr 11, 16 -17	96/16	
		Grand Bank (Div. 3LN)	May 28	96/26	
	Shrimp	0B, 2G, Hopedale and Cartwright Channels (2HJ), Hawke Ch. + 3K	Apr 11, 16 -17	96/17	
Newfoundland Region Salmonid Stock Assessment Committee					Can. Man. Rep. Fish. Aquat. Sci. 2385
	Atlantic salmon Arctic Char trout	Newfoundland Region	Feb 26 - Mar 1	96/80	
Marine Mammals					
	Hooded seals			Draft	
Regional Groundfish Stock Assessment Committee					DFO Atlantic Fisheries Proceedings 96/6
	Nfld Region Overview		May 6 -10	96/43	
	Cod	2GH, 2J3KL	May 6 - 10	96/44,	
		3Ps	Aug 12 - 18	96/45	
				96/81	
	Haddock	3LNO	May 6 -10	96/46	
		3Ps	Aug 12 - 18	96/82	
	Redfish	Subarea 2 + 3K	May 6 -10	96/47	
	American plaice	Subarea 2 + 3K	May 6 -10	96/48	
		3Ps	Aug 12 - 18	96/84	
	Witch flounder	2J3KL	May 6 -10	96/49	
		3Ps	Aug 12 - 18	96/85	
	American plaice	3Ps	Aug 12 - 18	96/84	
	Pollock	3Ps	Aug 12 - 18	96/83	
	Skates	3LNOPs	Aug 12 - 18	96/86	
	Lumpfish	3KLPs	Aug 12 - 18	96/87	
	Monkfish	3LNOPs	Aug 12 - 18	96/89	
	White hake	3LNOPs	Aug 12 - 18	96/90	
	Catfish	2J3KLNOPs	Aug 12 - 18	96/91	
	Blackback flounder	3KLPs	Aug 12 - 18	96/92	

NEWFOUNDLAND REGION OVERVIEW

Background

In Newfoundland, Science Branch of the Department of Fisheries and Oceans is responsible, either directly or indirectly, for advising on the status of various groundfish stocks extending from Davis Strait between Baffin Island and Greenland in the north to off the south coast of Newfoundland in the south.

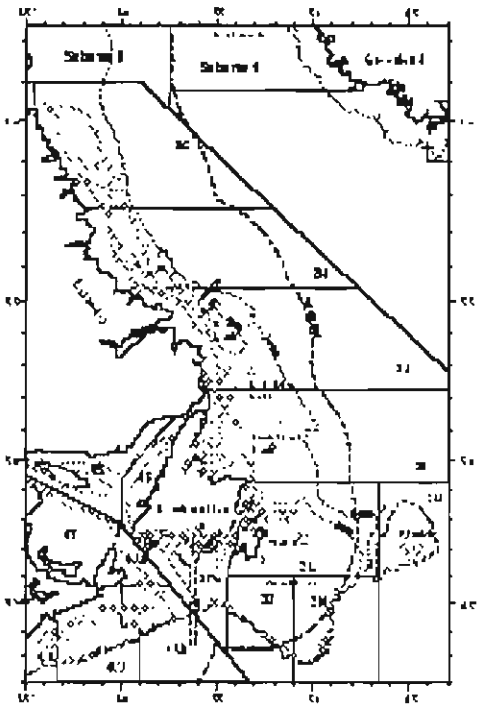
In this area, there are 5 cod stocks (2GH, 2J3KL, 3M, 3NO and 3Ps), 5 redfish stocks (SA2+3K, 3LN, 3M, 3O and Unit 2), 4 American plaice stocks (SA2+3K, 3LNO, 3M and 3Ps), 3 witch flounder stocks (2J3KL, 3NO and 3Ps), 2 Greenland halibut management areas (SA0+1 and SA2+3KLMN), 2 haddock stocks (3LNO and 3Ps), 1 yellowtail flounder stock (3LNO), 1 pollock stock (3Ps), 2 roundnose grenadier stocks (SA0+1 and SA2+3) as well as a portion of the 3NOPs4VWX Atlantic halibut stock. In addition, there is a fishery for lumpfish, as well as relatively new fisheries for monkfish and skates. These latter two came under quota management for the first time in 1995.

Scientific information on the above stocks is provided either through the DFO Science Branch regional review process and the FRCC, or the Scientific Council of NAFO. Quotas are set by the NAFO Fisheries Commission for 3NO and 3M cod, 3LN and 3M redfish, 3LNO and 3M American plaice, 3LNO yellowtail flounder, 3NO witch flounder, SA2+3 roundnose grenadier and SA2+3KLMN Greenland halibut. The NAFO Scientific Council also reviews the Canadian assessment of 2J3KL cod on an annual basis. Greenland halibut and roundnose grenadier in SA0+1 are managed bilaterally by Denmark, on behalf of Greenland, and Canada. Quotas for the other stocks are set by the Minister of the Department of Fisheries and Oceans based on recommendations of the FRCC.

The FRCC makes recommendations to the Minister on all groundfish stocks, advising either on catch levels, or recommending a Canadian position to be taken during NAFO Fisheries Commission meetings.

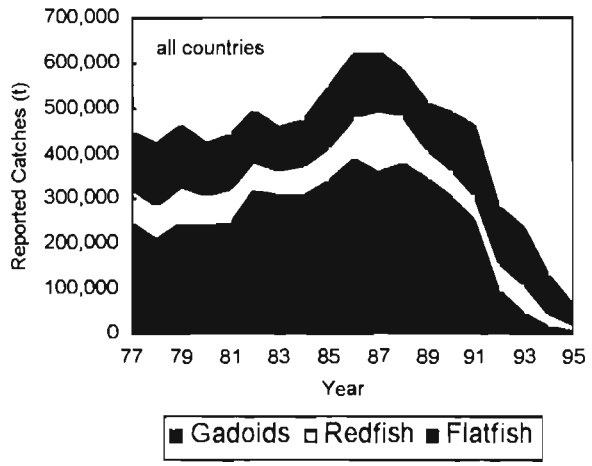
The Newfoundland Region Stock Status Reports contain information only for those stocks for which the FRCC provides direct catch recommendations to the Minister. Information on the stocks evaluated and managed by NAFO is contained in separate documentation; the reports of the NAFO Scientific Council.

Detailed technical information on each of the stock assessments can be found in the research documents listed with each stock report. Technical information for the NAFO stocks is available through the NAFO SCR Document series.



The Groundfish Fisheries

Cod has traditionally dominated catches in Newfoundland waters, but with the decline in these traditional resources, catches of other species exceeded those of cod in recent years. Significant reductions in catches of a number of different species and stocks occurred in 1995. For example, Greenland halibut catches in subareas 2+3 dropped from about 48,000 metric tons in 1994 to only about 13,000 metric tons in 1995.



Reductions of similar magnitude were recorded for most other species. These declines were the result of reduced fishing effort in the NAFO Regulatory Area. A significant reduction was even noted for Division 3M cod, with catches declining from about 32,000 metric tons in 1994 to about 10,000 metric tons in 1995.

Inside 200 miles, groundfish catches were once again dominated by Unit 2 redfish, although its was reduced by about 50% from the 1994 level.

In 1996 as in 1995, for the 'traditional' resources, only directed fisheries for Greenland halibut in SA0+1 and SA2+3KLMN; cod in 3M; redfish in 3LN, 3M, 3O and Unit 2; American plaice in 3M; and witch flounder in 3Ps are occurring. Fisheries for other species such as lumpfish, monkfish, wolffish, white hake, "black back" (winter) flounder and skates are also taking place.

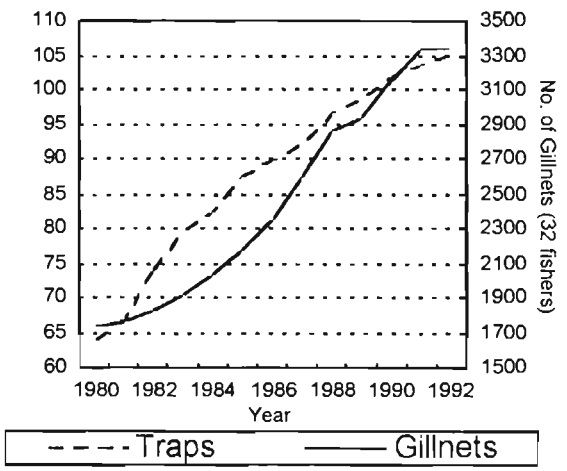
Information on offshore **fishing effort** in the Newfoundland area was presented in some detail in the 1995 Regional Overview. Because of the current very limited fisheries, there is almost no new information. Historically, most of the reported directed effort by all countries combined was toward cod with flatfish ranked second and redfish third. In recent years however, most of the reported effort has been for flatfish, specifically non-Canadian effort for Greenland halibut. Inside the Canadian zone, most offshore effort is being directed towards redfish, followed by Greenland halibut.

Since extension of jurisdiction, most **Canadian offshore effort** took place in Division 3L, while the least was in Division 2J. Currently it is most in the Unit 2 area (divisions 3P and 4V).

Non-Canadian effort declined after extension of jurisdiction in 1977, but increased significantly again, especially in divisions 3LN around 1985.

During the second half of the 1980s, reported non-Canadian offshore effort was restricted to only the 'nose' and 'tail' areas of the Grand Banks outside 200 miles. Nonetheless, this effort was about the same as, or even greater than that of the Canadian fleet fishing in the Canadian portion of the Grand Banks even though the area outside 200 miles is very much less than that inside. Effort outside 200 miles declined significantly during 1995 as a result of the 'turbot war.'

Effort information related to northern cod, obtained from **interviews of inshore fishers**, was made available this year. The data suggest substantial increases in inshore effort in the area of the Bonavista Peninsula during the 1980s. It might be hypothesized that similar increases occurred over time throughout much of the stock area.



Background to Groundfish Reviews

Unlike in previous years, the regional review of the status of the groundfish resources around Newfoundland has been divided into different time periods. The **'traditional' stocks off the**

northeast coast and on the Grand Banks (2GH and 2J3KL cod, 3LNO haddock, SA2+3K American plaice, 2J3KL witch flounder and SA2+3K redfish) were reviewed or updated during the usual time period in May.

The **'traditional' stocks found off the south coast** (3Ps cod, 3Ps haddock, 3Ps pollock, 3Ps American plaice and 3Ps witch flounder) will be reviewed in August.

The reason for this change is to better accommodate analysis of data collected during the 1996 3Ps survey which ended in early May. In addition, as outlined below, the region changed survey fishing gears during 1995 in order to catch more small fish as well as other species such as crab and shrimp. Additional time is therefore required to complete the analyses.

Division 3O redfish and **Unit 2 redfish** will be reviewed in detail during September, with a Zonal report available by the end of that month. This timing change first occurred during 1995, and was made so the redfish in units 1, 2 and 3 as well as Div. 3O could be reviewed together, and results of the summer surveys could be incorporated. As an interim measure, report updates containing information on the 1995 fisheries have been prepared.

Work is ongoing to evaluate, to the extent possible, the status of a number of other species/stocks such as lumpfish, skates, monkfish, white hake and wolffish. It is anticipated that this work will be reviewed and reports made available by the end of August.

This overview currently incorporates only information from the reviews of the northeast coast and Grand Bank stocks. It will be updated to include additional information after all of the regional reviews as well as the NAFO assessments are completed. The final version should become available by the end of September.

Groundfish Resource Status

Northeast Newfoundland and Grand Banks

The **'traditional' groundfish resources** in the waters around Newfoundland continue to be at or very near historical low levels. For Canadian managed stocks with TACs still in place, reduced TACs were imposed for 1995, and further reductions occurred for 1996. For example, the quotas for Unit 2 redfish have declined from 25,000 metric tons in 1994 through 14,000 metric tons in 1995 to only 10,000 metric tons in 1996.

For the **NAFO-managed resources** excluding those of Flemish Cap, directed fisheries remain open only for Greenland halibut and 3LN redfish in 1996. The NAFO Scientific Council continues to express concern that overfishing on these is gradually reducing stock sizes. Updated information on the status of these resources will be available in June 1996 after the annual meeting of the Scientific Council.

Because of the many closures now in place, data from fisheries-related activities which previously made up an important part of the assessment database, are no longer available. Ongoing assessments of these resources are more critically dependent on research activities such as research surveys and sentinel surveys.

In 1995 **Sentinel Surveys** began on both the northeast (2J3KL cod) and south (3Ps cod) coasts. For the first time, Departmental scientists are working closely with inshore fishers to derive information on the status of cod resources in the inshore areas. In addition to collecting data on catch rates, information on fish sizes, fish condition, and age and growth are being gathered.

Although the Sentinel Survey on the northeast coast began somewhat later than optimum in 1995, and although there is only one year's data available so far which limits their usefulness, it is anticipated that as the information base increases, these will serve as invaluable additions to our knowledge of the two cod stocks. It is

planned to have fishing gear in the water by early June in both areas for 1996.

Other Species Groups

Pelagic Fish Species

The offshore acoustic estimates of the capelin stock in Subarea 2 + divisions 3KL have been very low since about 1990. However, other indices, including inshore data, have suggested higher abundance during the same period. The reasons for the divergent results remain unclear. It does appear that the 1992 and 1993 year-classes are relatively abundant, and will contribute significantly to the 1996 spawning stock.

Capelin of these year-classes are smaller at age than those of the 1980s, similar to other recent year-classes.

Recent studies have shown that the recent delay in the time of capelin spawning is related to colder water temperatures as well as the overall smaller sizes-at-age.

The capelin stock in divisions 3NO remains at a relatively low level, and the fishery is closed again for 1996.

Herring stocks off the east and south coasts of Newfoundland are at low levels; with biomasses of only about 10% of the observed maximums. The low stock sizes are the result of recent year-classes being small in relation to the very strong 1968 year-class. The size of recent year-classes, as well as delays in the timing of spring spawning, have been related to the cold environmental conditions. The colder conditions have also resulted in lower growth rates through the 1990s.

Invertebrate Species

The shrimp stocks off the east coast of Newfoundland appear to remain very healthy based on high commercial catch rates, and the continuing high proportion of large females in the catches (reflecting a high spawning biomass). Based on the distribution of fishing effort during the 1990s, the distribution of shrimp is currently widespread and has possibly been expanding. Continuing high catch rates of the smaller males suggests continued good recruitment over the short term.

Crab landings have been increasing since about 1989, reaching an all time high of 32,000 metric tons in 1995. Effort has approximately doubled since the late 1980s. There are indications of catch rate declines in some inshore areas, but they have remained high in most offshore areas of divisions 3K and 3L.

On the Grand Banks, there are only a few locations where Iceland scallops are found in commercial quantities. Research data indicate that the beds of scallops in Division 3N are possibly being depleted.

Salmonids

From 1987 to 1992, survival rates of salmon (as estimated from the ratio of smolts leaving a river to the numbers of adults returning one year later) declined in many areas of Newfoundland. Studies of salmon in the ocean have revealed that survival is correlated to temperature of the surface waters of the ocean (called thermal habitat). The timing of return to rivers in Newfoundland has also been shown to be related to sea surface temperatures. Since 1992, survival rates have again increased perhaps indicative of a better 'thermal habitat.'

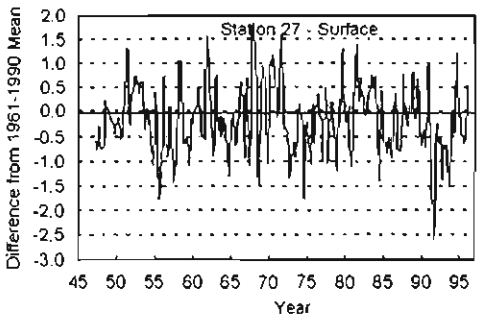
Marine Mammals

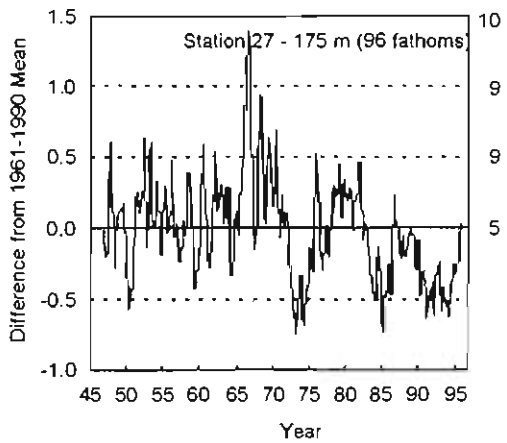
A considerable amount of new information on marine mammals, particularly harp seals, became available in 1995. Progress is continuing on studies of their abundance, distribution and diet.

The Environment

Colder than normal air temperatures were experienced in Atlantic Canada during the winter of 1994, but these had moderated to near normal by the spring of 1995. The above normal ice coverage during winter and early spring along the east coast of Newfoundland and Labrador had returned to near normal conditions by mid-May, 1996 except in a few isolated areas.

At Station 27 off St. John's, water temperatures were near normal during winter months, but cooled to 0.5 - 1.0 °C below normal by spring. By fall, temperatures had returned to near normal throughout most of the water column. Surface water temperatures were above normal by the end of the year, while the deepest water had returned to normal.

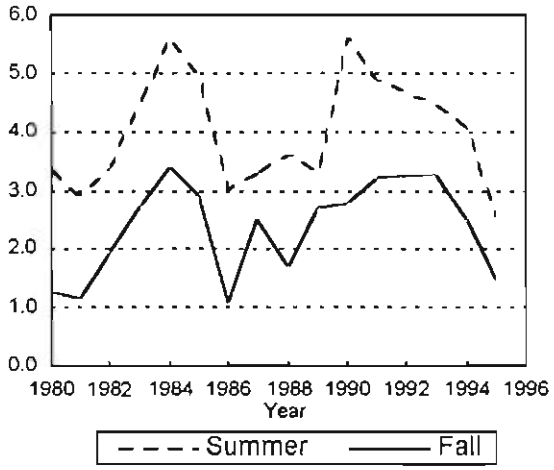




The cold intermediate layer (CIL) on the Newfoundland shelf was about 20% above normal along the Flemish Cap line, but 28% below normal along the Bonavista line and 32% below normal along the Seal Island transect.

With the exception of the northern Grand Bank, the cross-sectional area of the sub-zero °C water was the lowest in 10 years.

Overall, during both summer and fall, the estimated volume of the CIL was at or close to the lowest measured over the last 15 years.



Off the south coast, the relatively cold conditions which began around the mid-1980s have moderated somewhat, but below normal temperatures continued through 1995.

Ecological Perspectives

A number of **ecological studies** have been undertaken during the past year. It is hoped that these will assist our understanding of the marine ecosystem as it relates to commercial and non-commercial species.

A preliminary description of the temporal and spatial patterns in the variation of nutrients, phytoplankton and zooplankton in Newfoundland waters was developed. All of these exhibit seasonal cycles. For example, phytoplankton concentrations peak during April-May. In addition, there appears to be considerable variation in the cycles from one location to another. This may be due to such factors as mixing, mixed layer depths, nutrient sources and advection. Further studies are necessary, but this type of information is important in that the cycles and their timing may play a significant role in determining year-class success.

It has been shown that long-term fluctuations in seabird populations, their reproductive success and their diets all exhibit associations with oceanographic and climatic changes. Analyses of the foods brought to gannet chicks on Funk Island during the period 1977 through 1995

indicated that prey diversity increased, and also that there was a shift from migratory warm-water species to resident cold-water pelagic prey. These changes are indicative of large scale shifts in pelagic food webs associated with recent cooling trends in the northwest Atlantic. It is thought that data derived from studies of seabirds can compliment more traditional fisheries data collections and analyses.

Offshore Research Surveys

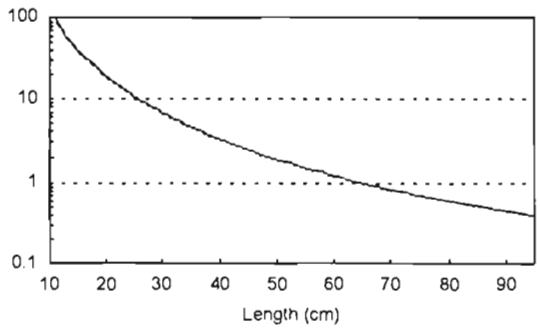
The Newfoundland Region has routinely had available two trawling research vessels for offshore studies: the *Gadus Atlantica* and *Wilfred Templeman*. An Engel 145 High Lift otter trawl was routinely used on both of these ships. In 1995, the *Gadus* was replaced by the new vessel *Teleost*.

Because of a desire to collect more reliable information on juvenile fish, as well as information on other species such as crab and shrimp, it was decided to change the research trawl used for the offshore surveys at the same time as the vessel change. Therefore, the gear used by both the *Teleost* and *Templeman* was changed to a Campelen 1800 shrimp trawl with 'rock-hopper' foot gear.

Different fishing gear will catch different sizes and quantities of fish species. Concurrent with the gear change, there was also a reduction in the duration of the standard tow from 30 minutes to 15 minutes. Therefore, before being able to relate catches from surveys using the new survey trawl and tow duration to those made in the past using the old survey trawl and 30 minute tow duration, it was necessary to conduct **'comparative fishing' experiments**. That is, fishing both nets in the same area at the same time and then comparing catches. In addition, because different vessels have different fishing powers, it is necessary to conduct these net comparison studies for both the *Gadus /Teleost*, and *Templeman* (Engel)/*Templeman* (Campelen).

During the past year, two separate studies were carried out. The first was a comparison of catches by the *Gadus* using the Engel trawl and the *Teleost* using the Campelen. This work has been completed, and conversion factors based on fish lengths for five species (cod, American plaice, redfish, Greenland halibut and witch flounder) have been derived.

Overall, the results indicate that the Campelen trawl has much higher catchabilities for smaller fish of all five target species; in the order of 50-100 times greater than catches by the Engel trawl. As fish size increases, differences in catchabilities declined to below a 1:1 ratio indicating that the Engel trawl is more efficient at catching larger fish. An example of the ratio between gears by length for cod illustrates the general relationship for the different species examined. The catch ratios shown are for the Campelen catches/Engel catches.



Time only permitted their preliminary application to the survey estimates for divisions 2J3KL cod this year as outlined in the Stock Status Report. Further scientific peer review of the conversion derivations will take place prior to wider application.

The second experiment, completed in March, 1996, compared catches by the *Templeman* using the Campelen with those of the *Alfred Needler* (sister ship of the *Templeman*) using the Engel. Analysis of the collected data is still ongoing, but because no large concentrations of some of the target species (cod, American plaice, yellowtail, witch and Greenland halibut) were located, the conversions will not be as well estimated as in the earlier experiment. Additional field work in this area will be necessary.

One further experiment is planned: a comparison of the Campelen on the *Templeman* with the Yankee 41 shrimp trawl on the *Needler*. This latter net was used previously for juvenile studies on the Grand Banks. Results of this last experiment will not have any impacts on the stocks evaluated as part of the regional process. Instead, the information from this study will have implications for Grand Banks stocks assessed by NAFO, specifically divisions 3NO cod and divisions 3LNO American plaice and yellowtail flounder.

Outlook

Overall, for stocks off the northeast coast, there are no signs of recovery primarily as a result of continued low recruitment. If these low recruitment levels have been at least partially the result of the cooler water temperatures experienced during the early 1990s, then it is possible that moderating conditions now being observed may result in improved chances of survival of these young fish.

There are however, some positive signs. Both condition factor and length-at-age of northern cod appear to be improving from the low levels of the early 1990s.

For More Information

Research Documents: Anon. 1996. Newfoundland and Labrador Snow Crab. DFO Atl. Fish. SSR 96/15.

Anon. 1996. Stock status update assessment of northern shrimp off Newfoundland and Labrador. DFO Atl. Fish. SSR 96/17.

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Wheeler, J.P. and G.H. Winters. 1996. Newfoundland east and southeast coast herring - an assessment to the spring of 1995. DFO Atl. Fish. Res. Doc. 96/63.

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DIVISIONS 2GH COD

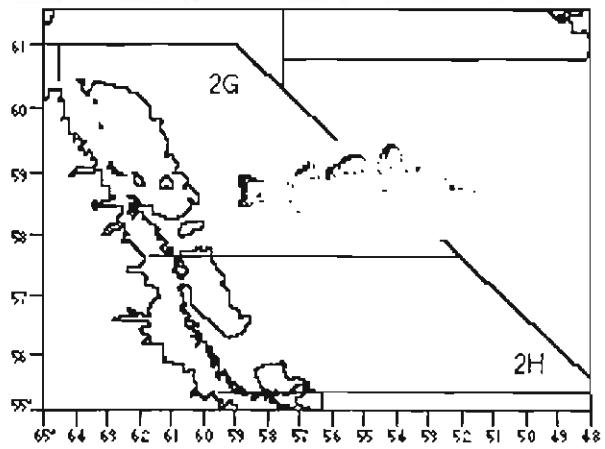
Background

Cod are found on both sides of the Atlantic. In the Northwest Atlantic, cod are distributed from Greenland to Cape Hatteras.

Cod in the Northwest Atlantic are managed as twelve stocks. Cod along the northern Labrador coast are managed as a stock delimited by NAFO divisions 2G and 2H. These cod overwinter along the continental slopes off Labrador from Saglek Bank to Hamilton Bank and migrate during the summer to coastal areas of northern and southern Labrador and northern Newfoundland. This distribution overlaps that of the 2J3KL cod stock complex to a large degree. The 2GH cod are managed separately from the 2J3KL stock complex because the effect of past fisheries in this region was more severe than further south.

The average annual catch from this stock from 1958 to 1964 was 5,000 metric tons of which Canada took 1,100 metric tons, all with inshore gears. From 1965 to 1969 average annual catches were 68,000 metric tons, but with Canada averaging only 675 metric tons. In 1970, the total catch had declined to only 18,000 metric tons, and catches continued to decline through the 1970s and 1980s, averaging 7,000 metric tons and 2,500 metric tons respectively in each decade. There have been no reported directed catches in recent years, although some catches occurred as by-catch in the shrimp fishery. The first quota was put in place in 1974 at 20,000 metric tons.

There is no time series of annual research surveys for this stock. Canada has conducted seven surveys with varying coverage since 1978 and all have indicated abundance and biomass to be very low.



The Fishery

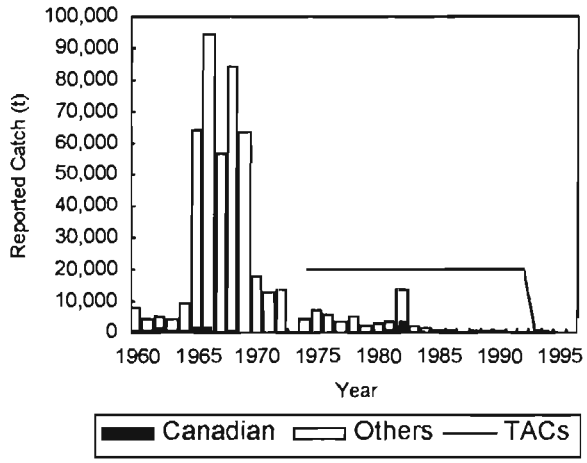
Annual catches since 1977 peaked at 14,000 metric tons in 1982 before declining to less than 500 metric tons in the late 1980s. Since 1991 there has been no reported catch. The current management plan recognizes that recovery of this stock is likely dependent on events in neighbouring stocks. The 1995 and 1996 TACs of 200 metric tons were established to allow for test fisheries. There was no cod directed activity in 1995.

Landings (thousand metric tons)

Year	60-76 Avg.	77-91 Avg.	1992	1993[1]	1994[1]	1995[1]	1996
TAC	N/A	N/A	20	20	1	.2	.2
Can.	.5	.5	0	0	0	0	
Others	26	2	0	0	0	0	
Totals	27	2	0	0	0	0	

[1] Provisional

The impact of bycatch in the shrimp and Greenland halibut fisheries on recovery has been an area of concern. The current protocol requiring mandatory use of the Nordmore grate in some shrimp management areas and its use in other areas when total groundfish by-catch exceeds 300 kg per day has been quite effective in reducing the by-catch of cod. Estimates from observer data show it has declined from 34 metric tons in 1992 to 1.1 metric tons in 1994. The impact of the Greenland halibut fishery should be negligible as this is mainly a deepwater gillnet fishery in the area of the continental slope.



Resource Status

Assessments of this stock cannot be updated because of the lack of recent information on the abundance and biomass in the area. The last survey to the area was conducted in 1991 and limited to coverage of 2H. Commercial catches have been low or non-existent since 1990, and as a result there are no commercial fishery data available either.

Research vessel surveys were conducted intermittently from 1978 to 1988 but the results could not be used as indicators of stock abundance because of limited coverage in the different years, and because of problems with the timing of the surveys in that they were conducted during the summer when the cod were inshore. The 1991 survey attempted to address these problems but this survey detected very few fish.

Outlook

The status of this stock is unknown. There has not been a research survey to the area since 1991. Since 1991 there have been no reported catches although estimates from observers indicate some by-catches in the shrimp fishery.

For More Information

Research Document: Murphy, E. 1995. The status of 2GH cod, 3LNO haddock, 3Ps haddock and 3Ps pollock. DFO Atl. Fish. Res. Doc. 95/33.

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NORTHERN (2J3KL) COD

Background

Cod are found on both sides of the Atlantic and from Greenland to Cape Hatteras in the Northwest Atlantic. Cod has traditionally been called the "Newfoundland currency," and played a significant role in the settlement of the island. Cod in the Northwest Atlantic are managed as twelve stocks.

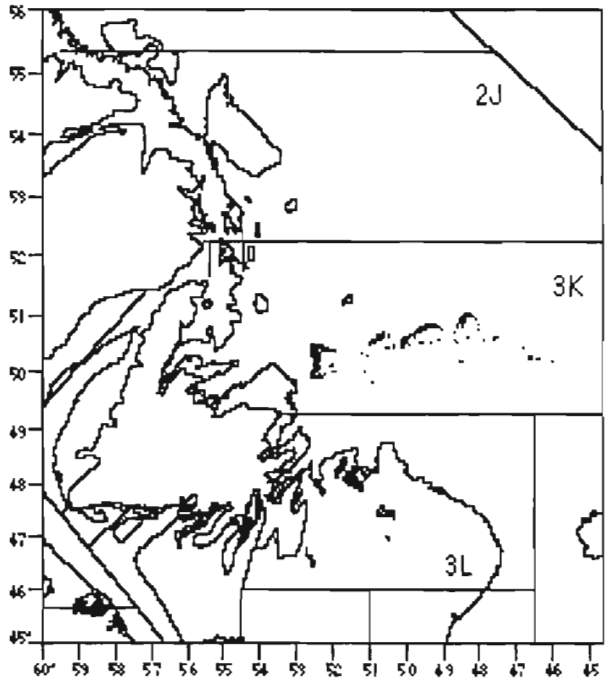
The northern (NAFO divisions 2J3KL) cod stock has been and is potentially one of the largest in the world and of vital importance to the economic and social structure of eastern Newfoundland and Labrador.

The stock covers about 117,000 square miles, and within this area considerable migrations occur, particularly between the inshore and offshore. Some fish overwinter in the inshore. The relationship between inshore and offshore fish is poorly understood.

Cod from this stock grow more slowly than in warmer areas. An age 5 cod would be about 50 cm.(about 20 inches) long. Throughout the area female cod have a variable age at maturity, presently about age 5.

Cod feed on a wide variety of food items but as adults take mainly capelin.

This stock has supported a commercial fishery since the 16th century. For the century prior to 1960 the catches were mainly between 200,000 metric tons and 300,000 metric tons. With high catches in the late 1960s, mainly by foreign fleets, the stock declined until the mid 1970s. Quotas were first put in place in 1973, but during the early years they were not restrictive. After the extension of jurisdiction in 1977, the stock increased until the mid 1980s but has declined more recently. The stock is presently at a very low level, probably less than 3% of that in the mid 1980s. A moratorium on fishing has been in effect since July, 1992.



The Fishery

Catches by non-Canadian fleets increased rapidly in the 1960s and, although inshore landings were declining over this period, the total catch reached a peak of 800,000 metric tons in 1968. As a result of these large catches the stock declined to a low biomass by 1977.

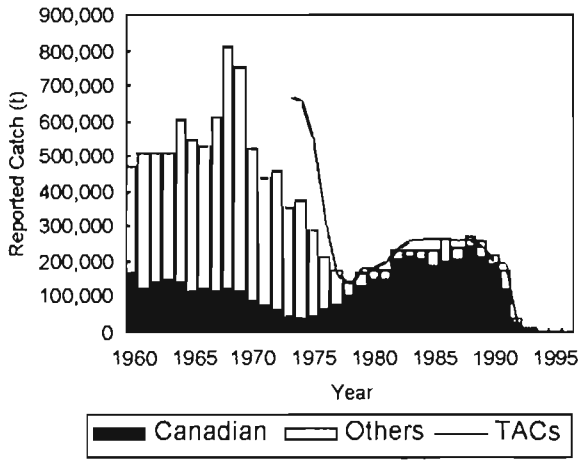
Landings (thousand metric tons)

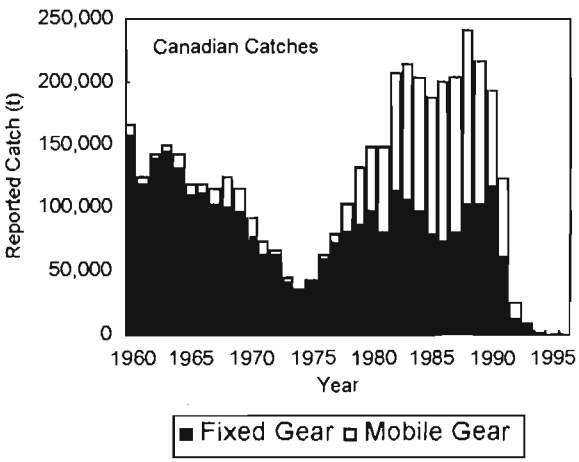
Year	62-76 Avg.	77-91 Avg.	1992	1993[1]	1994[1]	1995[1]	1996
TAC	N/A	N/A	0[2]	0	0	0	0
Can. Fixed	97	90	12	9	1	+	
Can. Mobile	7	84	14	+	0	0	
Others	386	38	15	2	+	+	
Totals	490	212	41	11	1	+	

[1] Provisional
[2] Moratorium imposed July 2, 1992
[+] Catch less than 500 metric tons

Following extension of jurisdiction the stock began to recover as a consequence of lower catches, strong 1973-75 year classes, and an increasing trend in fish growth rates. However the 1976 and 1977 year classes were weak and fish growth rates decreased in the early 1980s at

a time when fishing mortality was high, arresting the recovery of the spawner biomass after 1982. Catches varied throughout the 1980s. For the inshore the available data show that effort measured by horsepower, boat capacity and nets per person increased through the 1980s (see Regional Overview).





Although the 1978 to 1982 year-classes ranged from moderate to strong, growth rates were low. As a consequence of high catches the stock collapsed to exceptionally low levels by the early 1990s. A moratorium was imposed on directed commercial fishing in July 1992.

According to research survey indices at age 3, the 1984-88 year-classes that should have contributed to the fishery in 1992 were not detectably different from those of the previous 6 years; but these early indications were not borne out in the reported catches or in surveys after 1991.

Although catches from a recreational fishery were relatively high in the year following the moratorium, catches over the last two years are thought to have been minimal.

In an attempt to account for a greater proportion of the deaths attributable to fishing, **discards of cod** in the cod- and shrimp-directed fisheries have been estimated from observer records for the period 1980-94. Observer estimates of discards rose from less than 0.5% of the landings in 1980 to about 6.5% in 1986 and subsequently declined to around 2% in the early 1990s. These estimates do not include discarding by the inshore and foreign offshore vessels. Also, prior to 1986 not all Canadian vessels had observers on board.

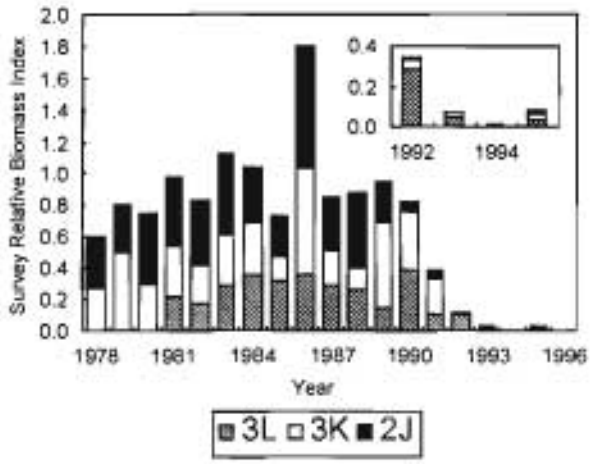
Analysis of tagging data suggest that **small fish** are relatively more abundant in traps, less abundant in gillnets and least abundant in line trawls. The implications of these results are being worked on.

Resource Status

Current **stock status** was estimated mainly using trends in abundance and biomass indices from annual **bottom trawl surveys**, conducted seaward of 12 miles at a time of the year when the stock is expected to be mainly offshore, and information from the **Sentinel Survey** carried out in 1995.

Autumn research vessel survey indices of relative cod **biomass and abundance** in divisions 2J3KL have indicated severe declines in recent years.

The 1995 estimate cannot be compared directly with the preceding estimates because of the change in survey gear and vessel, (see Regional Overview for details), however, the mean catch per tow remained exceptionally low throughout the survey area in 1995.



No significant aggregations of fish of any age were found during the 1995 bottom trawl survey. Cod older than age 7 have been virtually absent in these surveys since 1993.

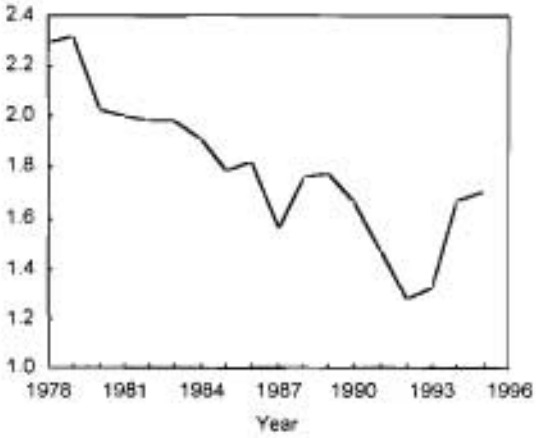
A large concentration of spawning cod was found in Smith Sound, Trinity. Hydroacoustic work in May 1995 suggested a biomass of around 17,000 t. Samples in December 1995 showed that the fish were mainly aged 3 to 8 and in good condition. Samples in April 1996 found them to be spawning again. The April 1996 survey also revealed adult cod in Northwest Arm and Southwest Arm, Trinity Bay. Unusually high parasite incidences suggested that these cod had resided in the inshore throughout the fall and winter months. Acoustic estimates of the biomass of cod in all three arms of Trinity Bay from the April 1996 survey are being prepared.

Although cod which remain inshore may have been a small component in the early 1980s when the stock was much larger, the virtual absence of cod in the offshore in recent years suggests that **inshore aggregations** may be very important for the recovery of the stock.

Of particular concern is the absence of any indication of good **recruitment**. Estimates of the abundance of pre-recruits (ages 0 to 2) were obtained from a variety of indices. The 1994 year class, which appeared strong at age zero now appears no stronger than the previous three year classes. The 1993 year class also now appears weaker than previously thought.

The **Sentinel Survey** in 1995 indicated that **catch rates** were lower than the last year of the commercial fishery off Labrador and the Northern Peninsula, same as the last year in White Bay, higher than the last year in Notre Dame Bay, and variable in Trinity Bay, Conception Bay and eastern Avalon. Fishers involved in the survey cautioned that high catch rates in some areas may have been a consequence of the lack of competition among gear because of the low levels of effort involved.

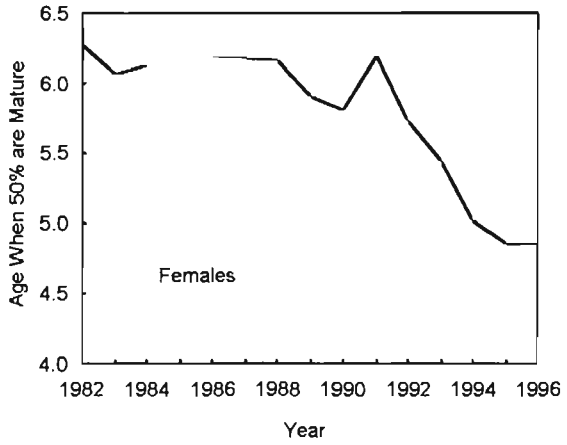
Growth, as measured by weight-at-age in the trawl survey samples decreased over the late 1970s and 1980s resulting in very low values by the early 1990s. Subsequently growth rates have shown signs of increasing. At least some of the variability in growth can be explained by environmental variables such as water temperature.



Condition factors, as measured by body weight relative to length, declined in the trawl survey samples from 1989 to 1992 in Division 2J and to a lesser extent in Division 3K. There was no apparent decline in Division 3L. The declining trend in condition appears to have reversed in 1993 and 1994. The 1995 value is similar to or lower than that for 1994, depending on the age of the fish. Reports from Sentinel fishers and biological sampling of the catch both indicate that fish in the 1995 Sentinel catch were in good condition.

Since about 1990-91, the age at which 50% of cod have been **maturing** has been declining. The

values for 1995 are the lowest in the time series.



Ecological Factors

Ocean conditions in 1995 were closer to the long-term average than in recent years. The volume of the cold intermediate layer (CIL) is close to the lowest level measured over the last 15 years (see Regional Overview) These changes may be beneficial to the stock in terms of recovery.

The **food** of cod includes a variety of prey. Capelin, which has historically been their major prey has been assessed to be at high abundance in 1995. However, capelin have been scarce in Division 2J in recent years. Northern shrimp, a moderately important prey on the Northeast Newfoundland Shelf, is at high abundance. Arctic cod, which has historically been a minor prey, appears to be at a high abundance. The status of most other important prey (e.g. hyperiid amphipods, sand launce, small snow crabs, euphausiids, miscellaneous species of shrimp and crabs) is unknown.

Harp seal numbers have increased substantially since the early 1980s and their consumption of cod as well as other fish species has consequently increased. Information on their feeding, based primarily on inshore sampling, indicates that cod, mostly age 3 and less, make up a relatively small portion of the diet. The harp seal diet analyses are currently being revised and estimates of potential impact should be available by early 1997.

Major Sources of Uncertainty

We do not know the abundance of cod inshore, what portion of it might constitute a genetically distinct sub-stock, and how such a substock, if it exists, might contribute to the recovery and sustainable harvest of the total resource. Similarly, inshore and offshore components might each consist of smaller subcomponents that might not recover easily from local depletions.

Changes in maturity and weight at age affect the ability of the population to replace itself and grow. The extent to which apparent changes can be explained by the environment (both physical and biological), by a response to changes in population size, by fishing and by sampling artifacts is not yet established.

Although the groundfish trawl surveys do not measure the abundance of cod in the inshore, they have been considered a reliable index of cod abundance outside 12 miles in the past. However, the substantial decrease in survey indices since 1992 in the absence of a commercial fishery currently lack explanation.

Although there is observer information on discards in the Canadian cod and shrimp offshore fisheries since about 1980, the extent of discarding in other fisheries is unknown.

Not all juvenile cod are found in trawlable habitats. The amount of cod in these habitats and the extent to which this varies over time has not been determined.

Outlook

None of the above uncertainties affect the basic conclusion: all indices available indicate that this stock is still at an **extremely low level**. The only significant aggregation of cod that has been studied in the last two years is in Smith Sound, Trinity Bay. The Smith Sound aggregation contained actively spawning fish in 1995 and 1996 and, together with other aggregations that may exist in the inshore, could hold the key to stock recovery, and therefore must be conserved to the fullest extent possible.

An analysis of the spawner stock and recruitment data indicates that **population growth rate** for Division 2J3KL cod at low population size should average about 18% per year. This analysis is consistent with other cod stocks at this temperature. However, recruitment values estimated for the last 10 years have nearly all fallen below the average stock-recruit relationship on which the 18% is based. This may indicate a change in the ecosystem and consequently much lower population growth rates may now apply.

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SUBDIVISION 3Ps COD

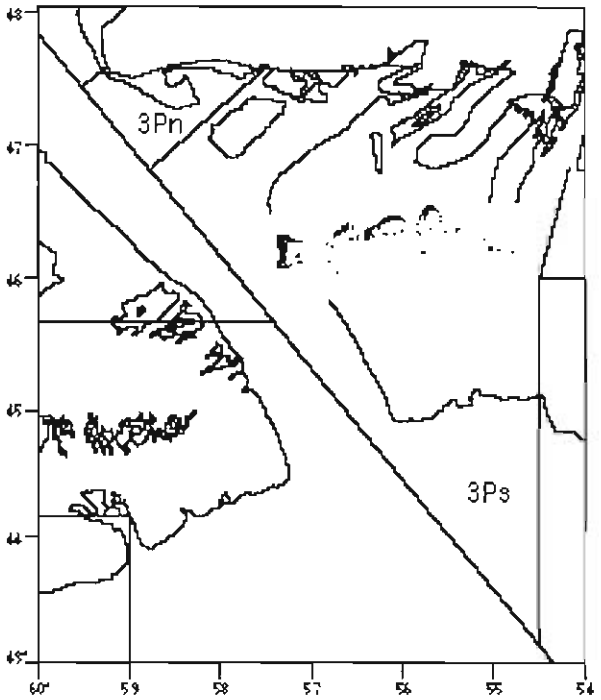
Background

Cod are found on both sides of the Atlantic. In the Northwest Atlantic, they are distributed from Greenland to Cape Hatteras and are managed as 12 stocks. The 'St. Pierre Bank' stock extends from Cape St. Mary's to just west of Burgeo Bank, and over St. Pierre Bank and most of Green Bank.

The distribution of fish does not conform well to management boundaries and the stock is considered to be a complex mixture of subcomponents. These may include fish that move seasonally into the area from adjacent stocks as well as fish that undergo migrations within the area. Fish are caught offshore by mobile gear and inshore by fixed gear. The extent to which the different components contribute to the fisheries is not fully understood.

Cod from this stock generally grow faster than those in more northerly areas. At least 50% of the females have been found to be mature by age 5 (53 cm (21 inches)) in recent years, compared to age 6 (58 cm (23 inches)) in the 1980s.

Catches from this stock have supported an inshore fixed gear fishery for centuries and have been of vital importance to the area. The stock was heavily exploited by Spain and other foreign fleets in the 1960s and early 1970s. French catches increased in the offshore throughout the 1980s. A moratorium on fishing has been in effect since August 1993.



The Fishery

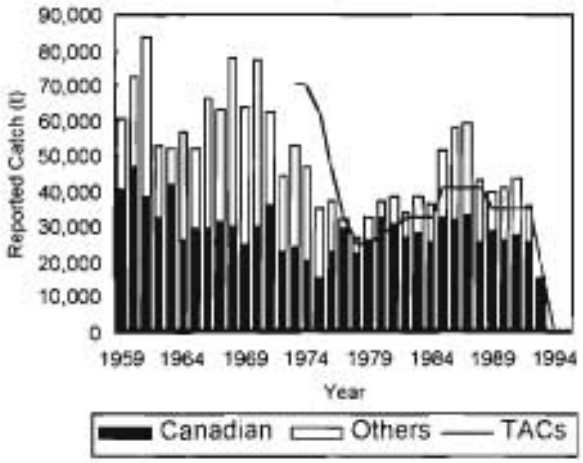
The stock was heavily exploited in the 1960s and early 1970s by foreign fleets, mainly from Spain, with catches peaking at 84,000 metric tons in 1961. After the extension of jurisdiction in 1977, cod catches averaged around 30,000 metric tons until the mid-1980s when increased fishing effort by France increased total landings to about 59,000 metric tons in 1987. Catches then declined gradually to 36,000 metric tons in 1992. A moratorium was imposed in August 1993 after only 15,000 metric tons had been landed. Although offshore landings have fluctuated, the inshore fixed gear consistently landed around 20,000 metric tons each year up until the moratorium.

A recreational food fishery was permitted for 8 days in 1994. About 493 metric tons of cod were taken before the fishery was closed, while a further 166 metric tons were taken as by-catch in other fisheries. In 1995 a Sentinel Survey was initiated involving limited fishing by commercial fishers for scientific purposes. Landings totaled 555 metric tons. By-catch accounted for a further 83 metric tons.

Landings (thousand metric tons)

Year	59-76 Avg.	77-90 Avg.	1992	1993[1]	1994[1]	1995[1]	1996[1]
TAC	-	-	35	20	0	0	0
Can.	30	29	24	15	.7	.6	
Others	28	11	7	+	0	0	
Totals	58	40	31	15	.7	.6	

[1] Provisional
[+] Catch less than 500 metric tons

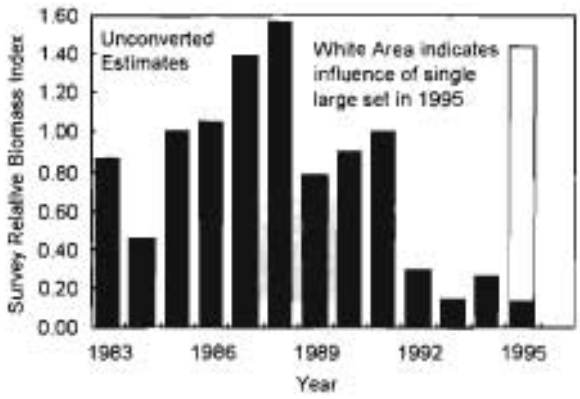


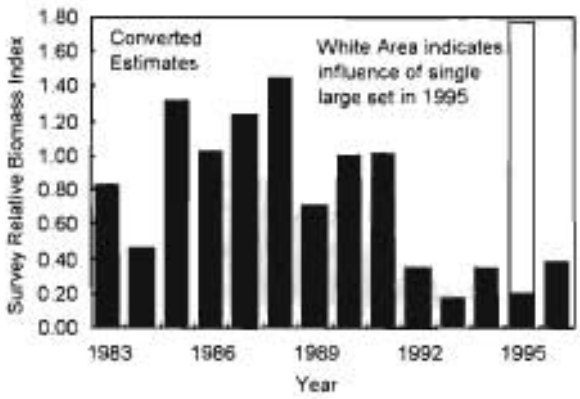
Resource Status

Stock status is estimated mainly using **abundance and biomass indices** from Canadian (1978-1996) and French (1980-1991) bottom trawl surveys, **commercial catch-at-age** from purchase slips and port sampling, **commercial catch rates** from log books of vessels 35 foot to 65 foot fishing fixed gear, and information from the 1995 **Sentinel Survey**. Data from an **acoustic survey** in Placentia Bay in November 1995 are also evaluated.

A reliable interpretation of stock status is impeded by severe problems of stock structure, seasonal migrations, variability in trawl survey estimates and poor commercial log book data. Analysis of the information required assumptions to be made which, in the light of these complications, are known to be oversimplified. Nevertheless, a variety of analyses were carried out in an attempt to extract as much information as possible on stock status from the available data.

The 1996 spring bottom trawl survey was the first carried out on this stock with the new Campelen 1800 shrimp trawl. Before the results could be compared with past surveys, the time series had to be converted to equivalent units based on the results of extensive comparative fishing experiments carried out with the old and new gear during 1995. The new trawl was found to be much more effective at catching small cod than the old gear but equally effective at catching large cod.

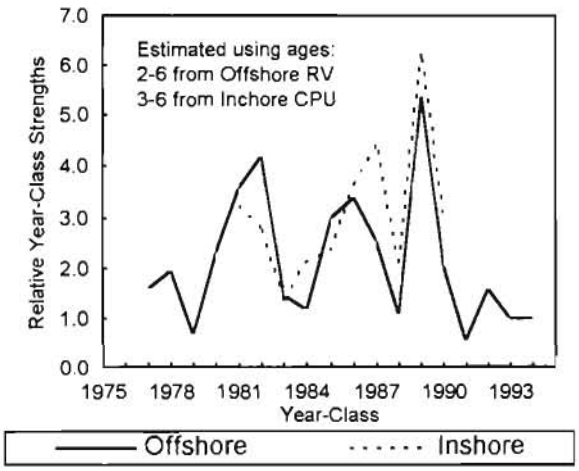




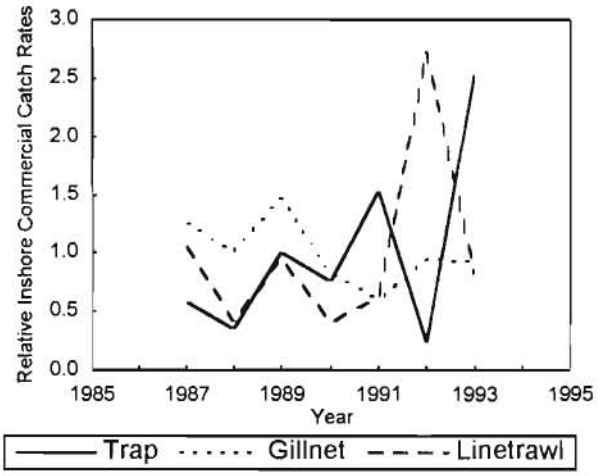
The **converted biomass index** from 1983 to 1996 shows considerable variability, and is low after 1991. The 1995 estimate is influenced by a single enormous catch contributing 87% of the biomass index. The 1996 biomass index is only slightly higher than the 1994 value. Fish were quite widely distributed over the survey area in the early 1980s, including on St. Pierre Bank, but in the more recent surveys have been found mainly on the slopes in the vicinity of Burgeo Bank and south of the Halibut Channel. From 1994 onwards additional strata were surveyed in

trawlable areas of Placentia Bay but at the time of these surveys (April) there have been almost no cod in these strata.

An analysis of **year-class strength** based on 1983 to 1996 **trawl survey data** for ages 2 to 6 shows that the 1989 year-class is the most abundant, that the 1990 year class is average and that subsequent year-classes are weaker. The 1991 year-class is estimated to be the weakest in the time series. Year-class strength estimated independently from **commercial inshore catch rate data** for ages 3 to 6 indicate a similar pattern for the period for which the two time series overlap.



Although the relative year-class strength estimates from inshore catch rates and trawl survey catches are similar, the annual average catch rates suggest a different trend in relative abundance in the inshore and offshore in recent years. The inshore catch rates do not reflect the decline in biomass in the early 1990s seen in the trawl surveys. However, it has not been established that inshore catch rates would reflect a decline in biomass were one to occur. Further, the catch rates are quite variable and contradictory among gears, especially in the last three years, and may not reflect changes in stock abundance.



The inshore catch rate data are only available for vessels 35 to 65 foot and the catch from these vessels for which effort data are recorded represents 2% or less of the fixed gear landings in most years. Inshore catch rate data may not therefore be representative of the inshore abundance of cod.

A fixed gear **Sentinel Survey** has been conducted at 12 sites along the south coast of Newfoundland from St. Brides to Ramea since late February of 1995 and is continuing in 1996. Sentinel catch rates were low in the first four months of 1995, at an intermediate level in the next four months, and exceptionally high in the last four months. Participants indicated that, overall, the catch rates experienced were better than in the year of closure, but cautioned that they may be artificially high because of the very restricted fishing activity. Commercial and Sentinel fishing practices were so dissimilar that the catch rates could not be combined into a single series.

An **acoustic survey** conducted in the inner portion of Placentia Bay in November 1995 gave a tentative estimate of 23,000 metric tons. Samples taken by jigger indicated that fish aged 5 and 6 predominated. An attempt was made to extrapolate this biomass to an estimate for the area covered by the **Sentinel Survey**, using the ratio of fish density in the acoustic survey to the catch rates experienced by Sentinel fishers. The biomass estimated in this manner exceeded 100,000 metric tons. The errors in this estimate

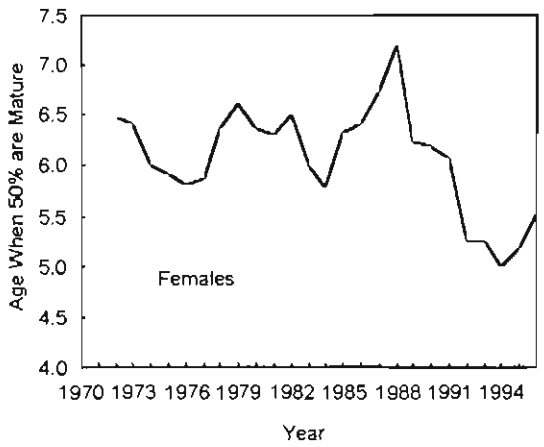
multiply as the consequence of several assumptions, including technical details of acoustics, extrapolation from the ship track to the whole of Placentia Bay, calibration with sentinel catch rates, extrapolation along the length of the coastline and how far fish extend offshore. The estimate was therefore considered to be extremely tenuous.

Stock structure and migration patterns of 3Ps cod are complex and not fully understood. The attempts to estimate stock size are complicated by a seasonal influx of cod from adjacent management units, notably the Northern Gulf (3Pn4RS) stock from the west during winter and possibly Southern Grand Bank (3NO) stock from the east and south during fall. Migration of offshore components of the stock to inshore areas during spring and summer, as well as the possible existence of inshore components that remain outside the survey areas throughout the year, also complicate the assessment of stock status. **Tagging studies** suggest that at least five components contribute to commercial catches in 3Ps; these include cod from the Northern Gulf, Burgeo Bank, southern St. Pierre Bank, Southern Grand Banks, and the inshore Avalon-Burin stock complex.

Sequential population analysis has been unable to reconcile total catch with offshore trawl survey estimates in recent assessments. Therefore in this assessment separate reconstructions were attempted from inshore fixed gear catches and offshore trawl catches from 1978 to the present. The basis for this is the hypothesis that there may be only limited mixing between these two components of the stock, as indicated by the difference in trawl survey estimates of abundance and inshore catch rate trends in recent years.

An attempt was made to calibrate the offshore analysis with the research trawl estimates; however the results were not considered satisfactory. Calibration of the inshore analysis with fixed gear catch rates from gillnets, linetrawls and traps for the period 1987 to 1993 suggested that this analysis was worth taking further. The biomass of cod in the inshore in 1993 was estimated to be about 100,000 metric tons, up from a low of about 80,000 metric tons in the late 1980s. In each of the years 1991 to 1993 there was one index, either line trawl or trap, that was very high and out of line with the other two. As noted previously, there are a number of concerns that high catch rates observed for these gears may not reflect stock abundance.

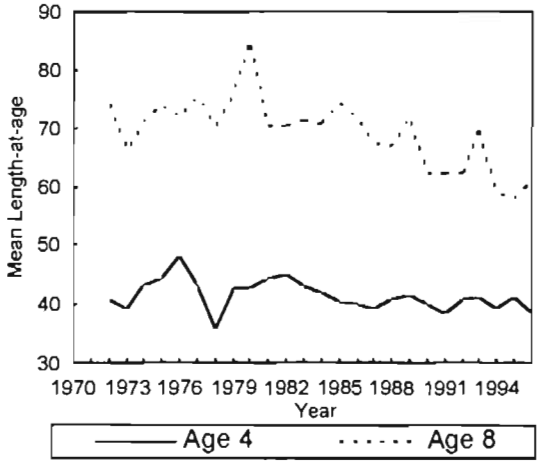
Given the uncertainty associated with the inshore catch rate time series used in the calibration, the estimates of inshore cod abundance were considered to be too unreliable to use in assessing stock status.



Age-at-maturity from trawl survey samples has typically averaged 6 years (58 cm (23 inches)) but has been declining in recent years. Age at 50% maturity for females dropped dramatically from a high of 7.2 years (65 cm (26 inches)) during 1988 to a low of 5 years (53 cm (21 inches)) during 1994. However, the estimates for the two most recent years indicate that the declining trend has reversed or at least halted with current (1996) estimates of age-at-50% maturity at 5.5 years (56 cm (22 inches)). Males show a similar trend although maturation generally occurs about 1 year younger for males. Maturities at age in the 1995 Sentinel Survey are almost identical to those found in the trawl survey.

Growth, calculated from length-at-age in trawl survey samples, varied with no trend (younger

ages) or declined (older ages) during the past decade.



Condition, as measured by gutted body weight and liver weight relative to body length, was low in fish sampled during the 1993-1996 surveys. However, it is not clear that the values were below normal, because the 1993-1996 surveys were conducted in April when condition is near the low point of the seasonal cycle, and only two of the earlier surveys (1978-1992) were conducted during April. The condition of fish sampled from the sentinel survey varied seasonally and spatially. Comparable data must be collected for several years before deviations from the norm can be detected. Sentinel fishers reported that fish were in good condition.

The **age composition** in both the survey and fixed gear catches indicate a sequential loss of older ages from the population. Further loss of older age classes has occurred even after the moratorium was imposed.

Environmental Factors

Time series of **temperature anomalies** at depths less than 75m show cold periods in the mid 1970s and since the mid 1980s, similar to conditions on the shelf along the east coast of Newfoundland. The most recent cold period, which started around 1984, continued in the early 1990s with temperatures up to 1°C below average, and up to 2°C below the warmer temperatures of the late 1970s and early 1980s in the surface layers. Temperatures in deeper water off the banks show no significant changes. Since 1991, temperatures have moderated somewhat in some areas, but large areas continued to have anomalously cold temperatures in 1995, particularly on the eastern portion of St. Pierre Bank. Results from the spring 1996 survey suggest that conditions are returning to more normal levels.

Major Sources of Uncertainty

The origins of fish that make up the 3Ps cod fishery are diverse and as yet not fully understood. This complicates the interpretation of trawl survey, Sentinel Survey and commercial catch data and reduces confidence in the results of sequential population analysis.

Catch rate information from the inshore fishery is only available for the period 1987 to 1993 and represents only a small percentage of the annual catch. There is considerable uncertainty in the interpretation of these data.

The catch rates experienced in the Sentinel Survey in the last four months of 1995 are much higher than those reported in the inshore fishery from 1987 to 1993. However, catch rates in the early part of 1995 were below average. There is considerable uncertainty in the correct interpretation of Sentinel Survey catch rates in terms of the current status of the stock.

Reasons for distrusting any extrapolation of the acoustic survey results from Placentia Bay are discussed above.

The timing of the trawl survey has varied considerably over the years. This introduces uncertainty in the interpretation of abundance estimates and trends in fish condition because of seasonal migration patterns and seasonal changes in the biology of cod.

The decline in cod abundance observed in offshore surveys is not compatible with catch rate time series in the inshore, results of the Sentinel Survey, and perceptions of fishermen. This introduces uncertainty in the interpretation of these data.

Introduction of the new trawl survey gear raises hopes for making more reliable estimates of year-class strength at younger ages. However, the uncertainties inherent in the low catches of small fish in the old gear can never be removed.

Outlook

The results of the trawl surveys suggest that the biomass of cod in the survey area declined to a low level in 1993 and may have increased only modestly since then. This decline and continuing low biomass in the offshore conflicts with trends in inshore catch rates and results of the 1995 and early 1996 Sentinel Survey. The perception of many fishers is that there has been a good recovery of the stock in the inshore in the last two years. They point to increased by-catch, sightings and sounder-recordings as supporting evidence.

A re-opening of the offshore fishery is not supported by trawl survey data.

Given the uncertainties and the lack of a firm conclusion on current stock size in the inshore, **it would be necessary to get more positive signs before considering a re-opening of the fixed gear fishery at historical levels.** There is an unquantified risk of over-exploitation, particularly if these components are restricted to localized areas such as Placentia Bay.

Based on the available data, a limited re-opening of the inshore fixed gear fishery may not compromise the recovery of the stock. However, the current state of the stock makes it particularly sensitive to the risk of depletion for the following reasons:

- fish abundance is low offshore and any contribution to the inshore is severely reduced;
- if the stock is dependent on a wide distribution of ages for spawning success, this wide distribution no longer exists and therefore recruitment success may be reduced;
- there are no signs of good recruitment subsequent to the 1989 year-class;
- information from fixed gears is limited to the nearshore and may not indicate a large total resource;
- although inshore information has not indicated a decline it has not been established that the indices are capable of indicating a decline were one to occur.

Given the uncertainties and risks associated with re-opening, as outlined above, prudence must be exercised in considering possible catch levels during the first year of any limited re-opening.

In the event of a reopened fishery steps should be taken to ensure that a number of different biological variables such as lengths, ages (otoliths) and maturities are very well sampled. Steps should be undertaken to enable provision of frozen samples of catches from different gears/areas throughout the year so as to enable more detailed biological sampling. In addition, detailed log-book information accurately reflecting catches and associated effort should be gathered from all vessel sizes involved in the fishery.

For More Information

Research Documents: Shelton, P.A., D.E. Stansbury, E.F. Murphy, J. Brattey and G.R. Lilly. 1996. An assessment of the cod stock in NAFO Subdivision 3Ps. DFO Atl. Fish. Res. Doc. 96/91.

Brattey, J. and M.J. Morgan. 1996. Temporal trends in the age and length at maturity of Atlantic cod (*Gadus morhua*) from NAFO Subdivision 3Ps. DFO Atl. Fish. Res. Doc. 96/92.

Brattey, J. 1996. Overview of Atlantic cod (*Gadus morhua*) stock structure in NAFO Subdivision 3Ps inferred from tagging studies. DFO Atl. Fish. Res. Doc. 96/93.

Colbourne, E. 1996. Oceanographic conditions in NAFO Subdivisions 3Pn and 3Ps during 1995 and 1996 with comparisons to the long-term (1961-1990) average. DFO Atl. Fish. Res. Doc. 96/94.

Davis, M.B. and H. Jarvis. 1996. Results from the inshore Sentinel Survey for cod in NAFO Subdivision 3Ps. DFO Atl. Fish. Res. Doc. 96/95.

Rose, G.A. 1996. Preliminary report of an acoustic survey of inner Placentia Bay, November 1995. DFO Atl. Fish. Res. Doc. 96/96.

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SUBAREA 2 + 3K AMERICAN PLAICE

Background

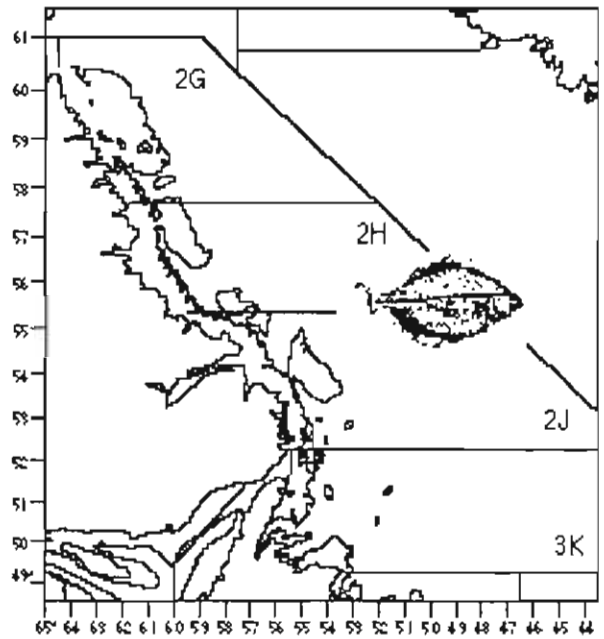
American plaice, which occurs on both sides of the North Atlantic, is a bottom dwelling flatfish. In the western Atlantic, the species ranges from U.S.A. waters to the Arctic, with the largest population historically occurring on the Grand Bank off Newfoundland. American plaice in the Labrador and northern Newfoundland region were usuolly found to be most abundant at depths less thon 250 m, although there has been a shift to deeper water since the late 1980s.

American plaice in NAFO Subarea 2 + Division 3K grow relotively slowly, entering the fishery at age 6 or 7, at a length of about 30 cm (12 inches). Most plaice are mature by age 9, at a length of about 38 cm (15 inches). Plaice up to 20 yeors old have been cought from this stock in the past, but few fish older than 14 years hove been caught recently.

Catches from this stock increased steadily throughout the 1960s, peaking at about 13,000 metric tons in 1970. Quotos were first put in place in 1974.

After the declaration of the 200 mile limit in 1977, non-Conadian catches were greatly reduced, with the total catch from the stock exceeding 2,000 metric tons on only 2 occasions after 1981. In most years the majority of the cotch came from the southern part of the stock, with catches from the northernmost areas being negligible. There have been inshore and offshore fisheries, with the major gears being gillnets and otter trawls respectively.

Stock size, as measured by research vessel surveys since 1977, peaked in the early 1980's, then declined by more than 90% to the early 1990's. Stock size has remained at a very low level in the 1990's, even though catches in recent years have been insignificant.



The Fishery

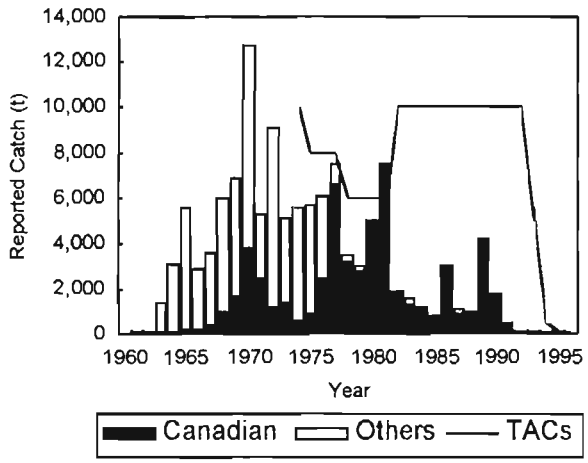
Catches from 1992 to 1995 averaged less than 70 metric tonnes per year, with the provisional estimate of catch in 1995 being only 23 metric tonnes. They are by far the lowest in the time series, due in part to the moratorium on the northern cod fishery, and drastic reductions in the American plaice TAC after 1993.

Landings (thousand metric tons)

Year	60-76 Avg.	77-91 Avg.	1992	1993[1]	1994[1]	1995[1]	1996
TAC	N/A	N/A	10	5	.5[2]	.1[2]	.1[2]
Can.	1	2.9	.1	.1	.1	.02	
Others	3	.2	0	0	0	0	
Totals	4	3.1	.1	.1	.1	.02	

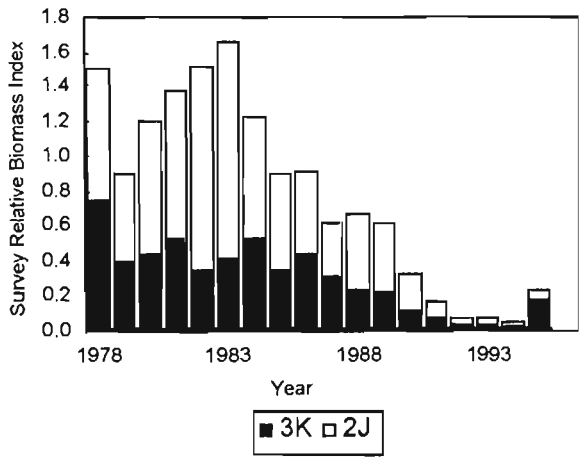
[1] Provisional
[2] By-catch only

In most years prior to 1992, a large percentage of the catch came from Division 3K, with recent exceptions of 1989 and 1990 when a directed fishery took place in Division 2J. In most years prior to 1991, the inshore catch from the stock ranged between 500 and 2,000 metric tons. The offshore catch fluctuated more widely, as the offshore fleet often chose to fish for American plaice in the southern divisions of Subarea 3, mainly divisions 3LNO.



Resource Status

No recent catch rate data are available from Canadian offshore otter trawlers, due to the very low catches in recent years. Catch-at-age data for the period 1984 to 1990, based on samples from the Canadian fisheries, show that American plaice aged 9 to 12 years comprised the bulk of the commercial fishery, and there was a declining trend in the catch numbers of older individuals up to 1990. For many years before 1984, and particularly for 1991 to 1995 when catches were very low, data are either non-existent or inadequate to estimate the commercial catch-at-age.



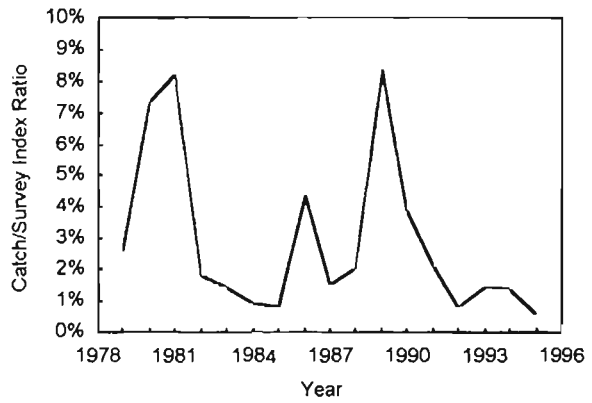
Research vessel survey information shows that the stock is currently at a very low level. In all surveyed areas, the **survey relative biomass index** declined substantially between the early 1980s and the early 1990s.

Shifts in the depth distribution of American plaice to deeper water occurred during 1986 to 1989 both in divisions 2J and 3K, and were followed by rapid, severe declines of the stock. In divisions 2J and 3K combined, the survey relative biomass index declined by about 95% between about 1982 and the 1990s. The 1994 values are the lowest ever observed in both 2J and 3K.

The 1995 survey was conducted with a different trawl gear (see Regional Overview), known to catch small American plaice much more effectively. Therefore the estimates from divisions 2J and 3K respectively are not directly comparable with previous ones. However, even with this change in survey gear, the overall survey biomass index in 1995 is only about 10% of the peak values seen in 1982-83. Analysis of comparative fishing data will be required to put the 1995 survey estimates in context with results from previous years.

There has been a gradual reduction in the numbers of older fish caught in the surveys, which is consistent with the commercial fishery data. The numbers of fish in all age classes declined at very high rates from 1990 to 1994, and recent estimates of **spawning stock size**, as measured by the surveys, are about 2 percent of peak values. There has also been decreased **recruitment** in recent years, although the decline is not as severe as the overall decline in stock size. Age specific data from the 1995 survey are not available at this time.

It is clear from the research vessel survey data that this stock declined to an extremely low level by 1992, and has remained low since then. Comparing the catch from the fishery with the biomass index from surveys indicates that **fishing mortality** alone cannot explain the magnitude of the declines in stock size since reported catches never exceeded about 9% of the survey biomass index. At present there is no explanation for the decline in this stock, or why it has remained so low since 1991 with virtually no fishery during that time.



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Ecological Factors

Factors such as anomalously low water temperatures since the mid-1980s, predation by seals, and migration have been hypothesized as reasons why stock size has decreased, but none of these has yet been demonstrated to be a major factor.

Outlook

Given the current stock size estimates from surveys, there can be no optimism about recovery of this stock in the **short or medium term**. Even with negligible catches, the stock has remained at a very low level since 1991.

The prospects for rebuilding in the **longer term** are unknown, although a recovery of the stock is unlikely before 10 to 15 years. The 1996 TAC of 100 metric tons is for by-catch only, with no provision for a directed fishery. Any fishery in 1997 could be detrimental to stock rebuilding, given the current low level of biomass.

For More Information

Research Document: Brodie, W.B., J. Morgan and W.R. Bowering. 1995. An update of the status of the stock of American plaice in Subarea 2 + Div. 3K. DFO Atl. Fish. Res. Doc. 95/35.

SUBAREA 2 + 3K REDFISH

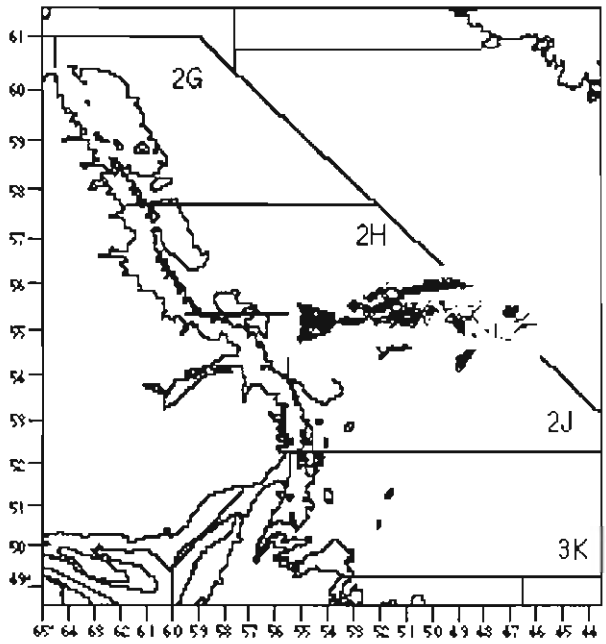
Background

Redfish, also known as ocean perch or rosefish, belong to a group of fishes that are commercially exploited in the Atlantic and Pacific oceans. They occur on both sides of the Atlantic ocean in cool, northern water (3° to 8° C) along the slopes of fishing banks and deep channels usually at depths of 100-700 m. In the west Atlantic redfish range from Baffin Island in the north to deep waters off New Jersey in the south.

Redfish are slow growing and long lived. They mate generally from September through October. The young are hatched inside the female and are born as free swimming larvae from April to July the following year. Females mature at 8-10 years old at a length of 25 cm (10 in), males generally younger and smaller, and enter the fishery at age 8-10. Redfish feed on a variety of small invertebrates and small fish and are eaten by such species as Greenland halibut, cod and seals.

The highest catch taken from this stock was 187,000 metric tons in 1959. Between 1961 and 1986 catches averaged about 27,000 t, with no less than 14,500 metric tons taken in any one year. From 1986 to 1991 catches declined from 18,500 metric tons to 280 metric ton due primarily to a major redirection of effort to other redfish fisheries by the principal Canadian stakeholder. The fishery was predominantly conducted by offshore otter trawlers and since 1979 primarily in Division 3K.

The fishery has been under TAC regulation since 1974 when a 30,000 metric tons TAC was implemented. The TAC was increased to 35,000 metric tons in 1980, decreased to 20,000 metric tons in 1991 and further reduced to 1,000 metric tons in 1994. For 1995 and 1996, 200 metric tons has been set aside for test fisheries.



The Fishery

There has not been constant directed effort on this stock since 1990 when 2,400 metric tons were landed from a directed fishery. Directed catches declined to 280 metric tons in 1991, and have been 15 metric tons or less in each year from 1992 to 1994. Redfish discards in the shrimp fishery amounted to 386, 185 and 110 metric tons in 1992, 1993 and 1994 respectively.

Landings (thousand metric tons)

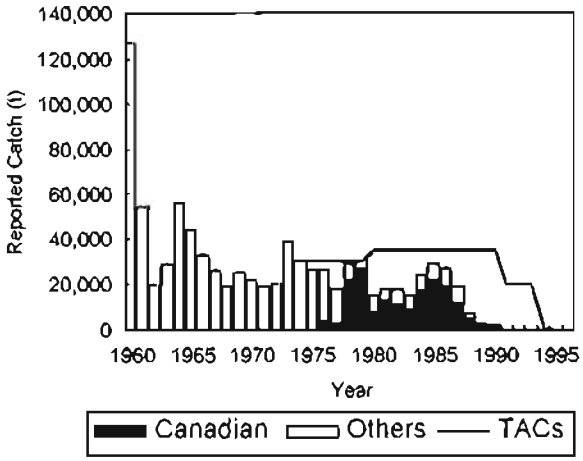
Year	60-76 Avg.	77-91 Avg.	1992	1993[1]	1994[1]	1995[1]	1996
TAC	N/A	N/A	20	20	1	.2	.2
Can.	.3	11	+	+	+	+	
Others	36	6	+	+	+	0	
Totals	36	17	+	+	+	+	

[1] Provisional
[+] Catch less than 500 metric tons

Reductions in TACs since 1991 were due to concern for the resource in light of continuous recruitment failure since about 1971.

In early 1995, National Sea Products Ltd. conducted a short experimental fishery in Division 3K on traditional redfish grounds. Although only a few sets were conducted the results were very poor as no fish were caught

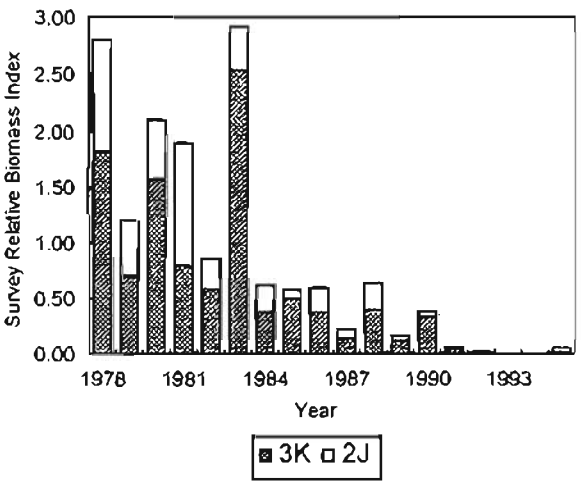
and no marks were encountered on the sounder while steaming.



Resource Status

In the mid-1980s, prior to the declines in catches, the bulk of the landings were of fish about 28 to 40 cm (11 to 16 inches) in length. This corresponds to ages between 10 - 20 years. There has been very limited commercial fishery data available since 1991 when this fishery became essentially a by-catch fishery.

Results from research vessel surveys in divisions 2J and 3K suggest **survey relative biomass indices** in both areas were at historically low levels in 1994.



Although there have been some large fluctuations between years in both divisions, there has been a general decline in the Division 2J relative biomass index of about 99% from 1978-1981 to 1992-1994. The Division 3K relative biomass index suggests an even greater reduction, about 95.5% during the same period.

The 1995 survey relative biomass index for Division 2J and 3K cannot at this time be related directly to historical estimates because of a change in survey gear, vessel, and duration of standard tow (see Regional Overview). Although the new trawl resulted in higher catches of fish less than 35 cm (14 inches), the index is still low compared to estimates from the mid 1980s.

There have been about 25 years of continuous **recruitment** failure since the strong year-classes of the early 1970s.

Since redfish are slow growing and long-lived (some have been aged as old as 80 years), recruitment failure alone cannot account for the observed decline in the stock.

Outlook

This stock remains at an extremely low level. Recruitment has been very poor since the year-classes of the early 1970s. From a conservation point of view, exploitation of this stock is unjustifiable. There have been no indications that the status of this stock will change in a positive way in the foreseeable future. Any good recruitment coming into this stock will need at least 10 years before it will start contributing to any fishery because of the relatively slow growth rate of redfish.

For More Information

Research Document: Power, D. 1995. Status of redfish in Subarea 2 + Division 3K. DFO Atl. Fish. Res. Doc. 95/25.

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DIVISIONS 2J3KL WITCH FLOUNDER

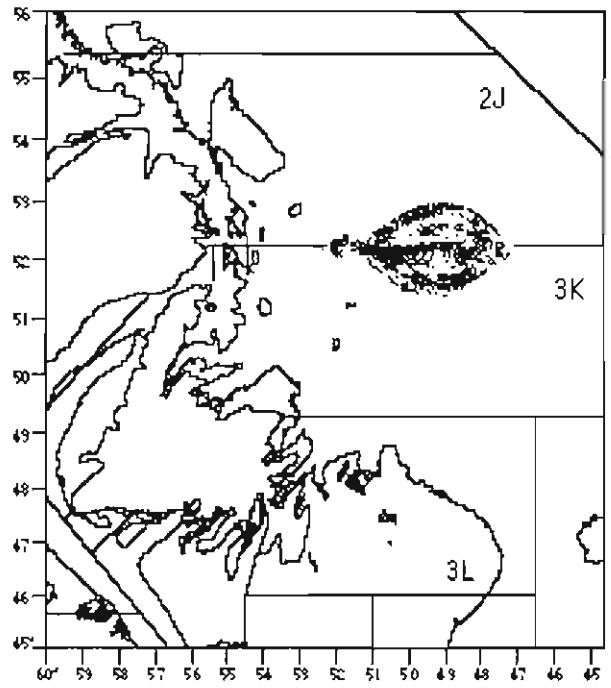
Background

Witch flounder is a deepwater flatfish which reaches its northern limits in the northwest Atlantic near Hamilton Bank off southern Labrador but extends as far south as the east coast of the southern United States. Although traditionally it has been most abundant in depths of about 200–400 meters (109–219 fathoms) in divisions 2J3KL, more recently it has been caught mainly in depths well in excess of 900 meters (492 fathoms).Witch flounder are generally associated with deep holes and channels running between the fishing banks as well as the slope area of the continental shelf and prefers a bottom of mud or muddy sand. Its main area of distribution is in Division 3K followed by Division 3L with very low numbers found in Division 2J

It is a long lived slow growing species and has been aged to over 30 years old. However, the number of age groups comprising the witch flounder stock in divisions 2J3KL has been reduced substantially since the mid 1970s and fish older than 14 years are now rarely seen in either the commercial or survey catches.

Spawning occurs over a rather prolonged period usually extending from March through to September in the Northwest Atlantic, however in the divisions 2J3KL area spawning takes place from March to July with highest intensity in the period March to May. During the winter and spring months witch flounder can be found in dense prespawning and spawning concentrations along the continental slope of Division 3K and it is here at this time when most commercial fishing operations occur and catch rates are highest.

The fishery began back in the 1960s, and has continued to the present. The first quota was put in place in 1974 at 22,000 metric tons in 1973. The peak catch was 24,000 metric tons, but catches declined under quota management and averaged only about 3,500 metric tons during the first half of the 1980s. The stock was relatively stable during this period, but declined rapidly thereafter. Recent data suggest that the stock may have declined by as much as 40 times since the early 1980s.



The Fishery

The commercial fishery began for witch flounder in this area in the early 1960s and catches increased steadily from about 1,000 metric tons in 1963 to a peak of over 24,000 metric tons in 1973. Catches declined rapidly to only 2,800 metric tons by 1980, then subsequently fluctuated between 3,000 and 4,500 metric tons to 1991. The catch in 1992 declined to 2,300 metric tons, the lowest since 1964, and further declined to 342 metric tons in 1993. Catches of only 12 and 0.5 metric tons were reported for 1994 and 1995 respectively.

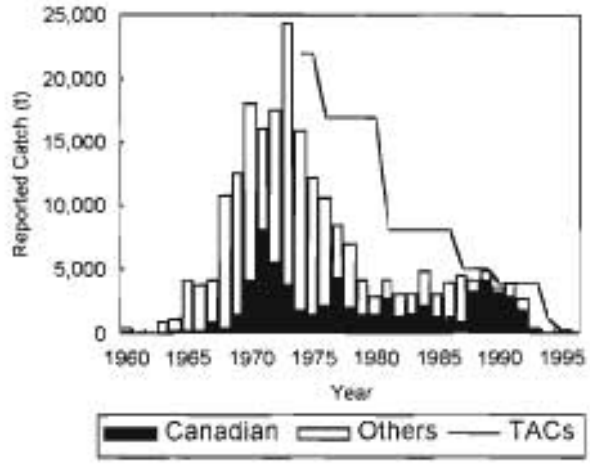
Landings (thousand metric tons)

Year	60-76 Avg.	77-91 Avg.	1992	1993[1]	1994[1]	1995[1]	1996
TAC	N/A	N/A	4	4	1	.1[2]	.1[2]
Can.	2	2	2	.3	+	+	
Others	7	2	.6	0	0	0	
Totals	9	4	3	.3	+	+	

[1] Provisional
[2] By-catch only
[+] Catch less than 500 metric tons

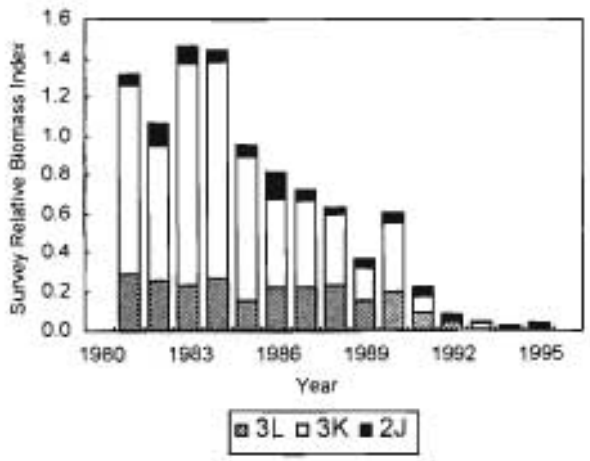
Up until the late 1980s the fishery was prosecuted by Poland, USSR and Canada primarily in Division 3K. In recent years, the

fishery has been mainly Canadian although some catches were estimated as taken by European Union (EU-Portugal) in the NAFO Regulatory Area of Division 3L. For both 1994 and 1995 no catches of witch flounder were estimated for the Regulatory Area of Division 3L. However, Canadian surveillance authorities indicate that witch flounder catches in the NAFO Regulatory Area of Division 3L are again increasing in 1996.



Resource Status

Research vessel surveys have been conducted in the fall in divisions 2J and 3K (to 1,000 m - 547 fathoms) and 3L (to 730 m - 400 fathoms) since 1977, 1978 and 1981 respectively.



For Division 2J, **survey relative biomass index** ranged from a high in 1986 to less than 4% of that level in 1994. In Division 3K, during 1979–85, there was a period of relative stability, but since that time, the estimates have declined considerably to about 1% of this level in 1994, the lowest in the time series. For Division 3L, the survey index remained fairly stable from 1981–1988 but has declined rapidly since then by about 75% by 1992, and by about 95% in 1993 and 1994. For the three divisions combined, there has been a very steady and rather systematic decline from about 1984 through 1994, with the 1994 estimate being the lowest in the time series.

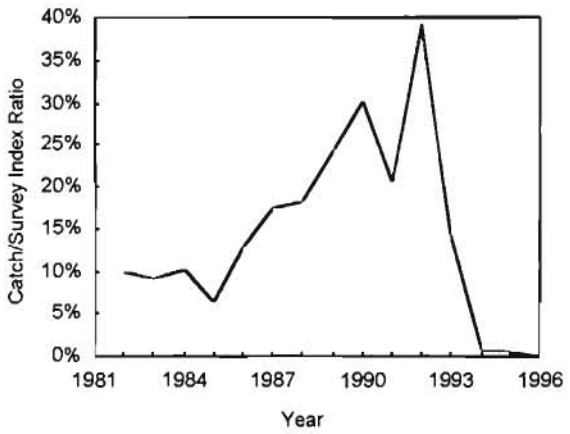
A survey was conducted in 1995 using different vessel-gear combinations and therefore cannot be put in the same context as previous surveys (see Regional Overview). The survey relative biomass index estimate for divisions 2J3KL combined was nevertheless, near the lowest observed.

In the earlier years, the stock in all divisions was generally distributed in depths less than 500 meters. Since 1989 however, most witch flounder have been found in depths greater than 500 meters.

Deepwater surveys directed primarily towards Greenland halibut were conducted to 1,500 meters (820 fathoms) in divisions 3KLMN during 1991, 1994 and 1995. Results indicate that witch flounder have become somewhat more abundant in the NAFO Regulatory Area in divisions 3LM (Flemish Pass). This suggests that at least some of this witch flounder stock may have migrated there from inside the Canadian zone.

Based on the size distribution of witch flounder caught during the surveys, there has only been poor **recruitment** to the resource for a number of years.

This stock has declined to levels far below anything observed in the past with no signs of improving recruitment. It is also apparent that during the 1980s, the magnitude of the decline in the biomass index observed in the surveys cannot be fully explained by the removals of the commercial fishery as the commercial catch over trawlable biomass ratios are generally quite low during most of the period.



However, given the **shrinking area of distribution** in recent years, coupled with the fact that fishing was most intense in this area (depths greater than 1000 m (546 fathoms) upon prespawning aggregations, it is probable that recent catches may have accelerated the decline over the last few years.

Outlook

This stock is at an **extremely low level** and any exploitation of it in its present state continues to be unjustifiable from a conservation point of view. Based on recent indicators of continuing poor recruitment, there is nothing to suggest that this stock will increase in the foreseeable future. Any fishery in 1997 could be detrimental to stock rebuilding.

If the stock has migrated (at least in part) to the NAFO Regulatory Area as suggested from the deepwater survey data, then it could be subjected to unregulated fishing. Early observations in 1996 from Canadian Surveillance indicate that this is already the case.

For More Information

Research Document: Bowering, W.R. 1995. Stock status update of witch flounder stock in divisions 2J and 3KL. DFO Atl. Fish. Res. Doc. 95/37.

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DIVISIONS 3LNO HADDOCK

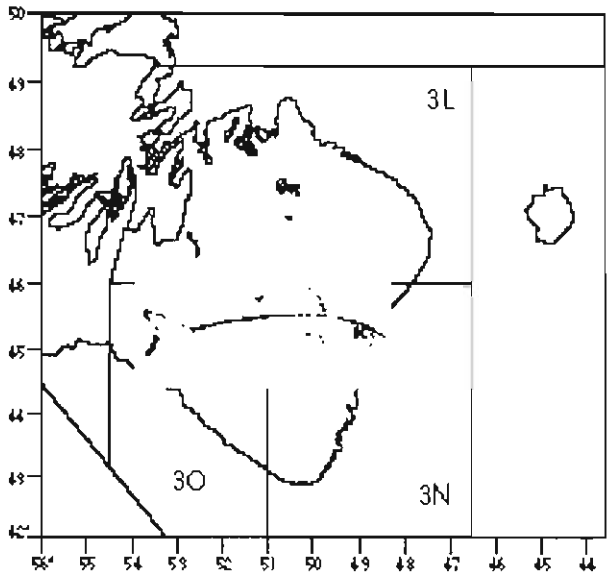
Background

Haddock occur on both sides of the North Atlantic. Along the coast of North America, it occurs from the Strait of Belle Isle south to Cape Hatteras being more abundant in its southern range.

Haddock are primarily bottom feeders and food varies with size. Those less than 50 cm (20 inches) eat crustaceans, in particular amphipods, pandalid shrimp and hermit crabs. Also a part of the diet are echinoderms (brittle stars, sea urchins and sand dollars), mollusks, (snails and clams) and annelid worms. For haddock greater than 50 cm, small fish make up about 30 percent of the diet with sand lance, capelin, silver hake, herring and argentines being consumed. When available, large numbers of herring and capelin eggs are eaten. Haddock larvae are pelagic and settling occurs at just under 50 mm (2 inches). Males and females reach sexual maturity at ages 3-5, males usually at slightly younger age than females. Growth rates vary from stock to stock with generally slower rates in northern stocks.

The history of the haddock fishery in NAFO Subarea 3 is a relatively short one. Prior to 1945 catches on the Grand Bank (NAFO divisions 3NO) were low but increased rapidly in the late 1940s and remained high until the early 1960s. There is evidence to suggest that haddock were abundant earlier but were not a desired species in a saltfish operation and were not kept or recorded separately. The high catches of the 1950s and early 1960s were the result of several strong year-classes. The fishery of this era was characterized by high discard rates, 30 to 40% by weight and 50 to 70% by numbers. Catches since the 1960s have declined to very low levels with some peaks at 8,000 to 10,000 metric tons when good year-classes occur.

TACs were first put in place in 1987, and have ranged between 4,100 and 10,000 metric tons since then. Advice from CAFSAC in the late 1980s and early 1990s was that there should be no directed fishery on the stock in order to allow relatively strong year-classes to reach maturity.



The Fishery

Historically, landings by the Canadian fleet were highest in Division 3O and were mainly taken during the January to May period in warmer slope waters. Landings were highest during the 1950s and early 1960s with a maximum of 76,000 metric tons reported in 1961. These catches were supported by the presence of the strong 1949 and 1955 year-classes. Landings remained low from the 1960s to mid 1980s as a result of poor recruitment. Landings increased to 8,200 metric tons in 1988, the highest since 1967. They have since declined to less than 1,000 metric tons annually.

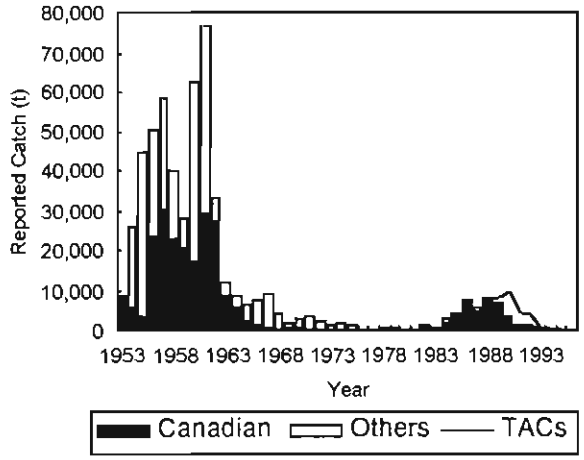
Landings (thousand metric tons)

Year	53-76 Avg.	77-90 Avg.	1991	1992[1]	1993[1]	1994[1]	1995
TAC	N/A	N/A	4	.5[2]	.5[2]	.1[2]	.1[2]
Can.	9	2.4	.8	.9	+	+	
Others	12	.4	.2	+	+	0	
Totals	21	2.8	1	1	+	+	

[1] Provisional
[2] By-catch only
[+] Catch less than 500 metric tons

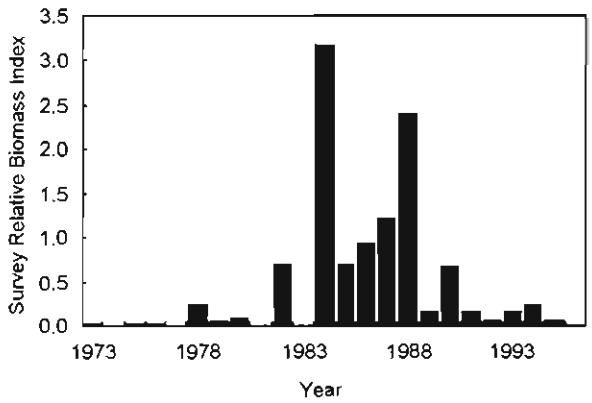
The provisional catches for 1994 and 1995 were only 8 and 22 metric tons respectively. These are the lowest catches on record, and are partially due to the moratoria on cod and flatfish stocks in

the divisions 3NO area first imposed in 1994 by NAFO.



Resource Status

Research surveys have been conducted in the area since the early 1970s, but coverage during the 1970s was not as extensive as in the more recent period. Very few haddock were ever found in Division 3L during the spring surveys.



The **relative biomass index** was low throughout the 1970s, highest in 1984, declined sharply in 1985, then showed a gradual increase to 1988. The increases were due to growth of the relatively strong 1980 and 1981 year-classes.

The index has been low since, with the 1994 and 1995 estimates being similar to those of the 1970s.

Abundance at age information from the surveys shows recent **year-classes** are weak.

The level of **fishing mortality** for this stock is not known but it is believed to have been high during the late 1980s. During this period, greater than 50% of the catches were taken in directed fisheries. The NAFO moratoria on the cod and flatfish fisheries, along with the decline in the size of the haddock stock have probably all contributed to recent lower fishing mortalities.

Ecological Factors

Haddock in Newfoundland waters are thought to be at the northern extension of their range in the Northwest Atlantic. Oceanographic data for 1995 indicate that water temperatures on the plateau of the Grand Bank remain below long term means, but they were somewhat warmer than in 1994. The colder conditions throughout the area in recent years have probably impacted on haddock distribution and behaviour.

Outlook

There have been no signs of good recruitment in the survey catch-at-age in recent years, and therefore no prospects of the stock improving in the near future.

Haddock in this area show considerable variation in recruitment but the mechanisms are not understood. In the past, good year-classes have been fished out before they reached spawning age. When stronger year-classes are detected, if an approach of allowing the fish to at least reach spawning age is adhered to, subsequent recruitment should be enhanced.

For More Information

Research Document: Murphy, E. 1995. The status of 2GH cod, 3LNO haddock, 3Ps haddock and 3Ps pollock. DFO Atl. Fish. Res. Doc. 95/33.

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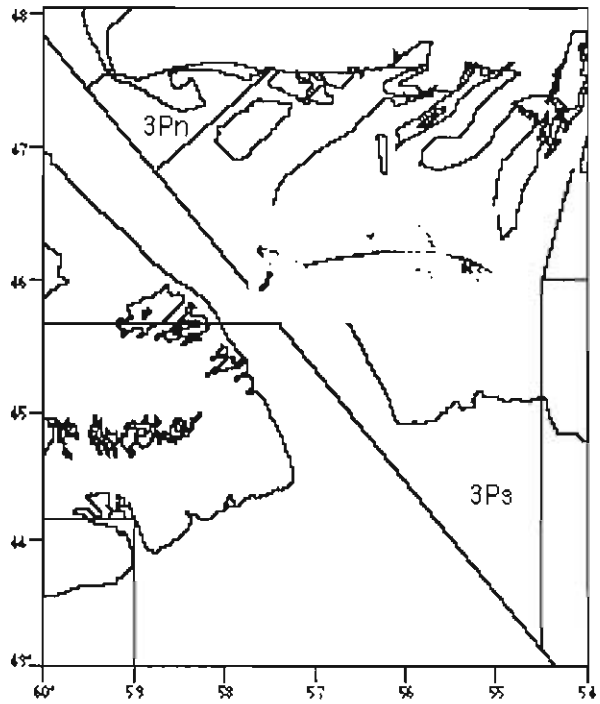
SUBDIVISION 3Ps HADDOCK

Background

Haddock occurs on both sides of the North Atlantic. Along the North American coast it occurs from the Straits of Belle Isle south to Cape Hatteras being more abundant in its southern range.

Haddock are primarily bottom feeders and food varies with size. Those less than 50 cm (20 inches) eat crustaceans, in particular amphipods, pandalid shrimp and hermit crabs. Also a part of the diet are echinoderms (brittle stars, sea urchins and sand dollars), Mollusks, (snails and clams) and annelid worms. In haddock greater than 50 cm (20 inches) small fish make up about 30 percent of the diet with sand lance, capelin, silver hake, herring and argentines being consumed. When available, large numbers of herring and capelin eggs are eaten. Haddock larvae are pelagic, settling when just under 50 mm (2 inches). Males and females attain sexual maturity at ages 3-5; males usually at a slightly younger age than females. Growth rates vary and are generally slower in northern stocks.

The history of the haddock fishery in NAFO Subarea 3 is a relatively short one. Haddock were not known to exist in abundance on St. Pierre Bank before 1950. The appearance of the very abundant 1949 year-class lead to an increase in catches with a peak at 58,000 metric tons in 1955. The fishery of this era was characterized by high discard rates, 30 to 40% by weight and 50 to 70% by numbers. This was the result of 70 to 100 mm mesh size in codends and a requirement by plants for landed fish to be at least 45 cm.



The Fishery

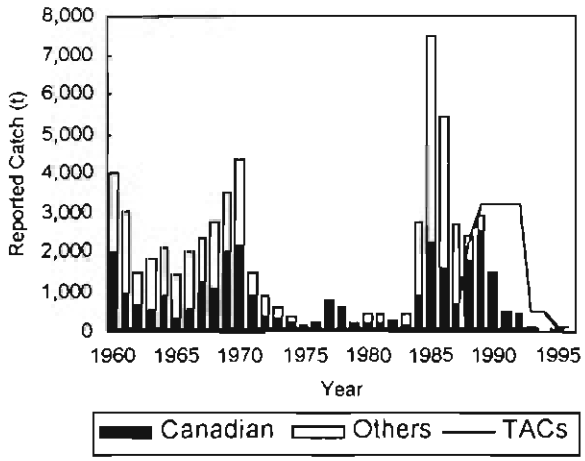
Landings increased from 5,800 metric tons in 1953 to peak of 58,000 metric tons in 1955 then declined to 6,000 metric tons in 1957.

Landings (thousand metric tons)

Year	60-76 Avg.	77-90 Avg.	1992	1993[1]	1994[1]	1995[1]	1996
TAC	-	-	3.2	.6[2]	.5[2]	.1[2]	.1[2]
Can.	.9	.8	.5	.1	+	+	
Others	1	.8	0	0	0	0	
Totals	10	2	5	1	+	+	

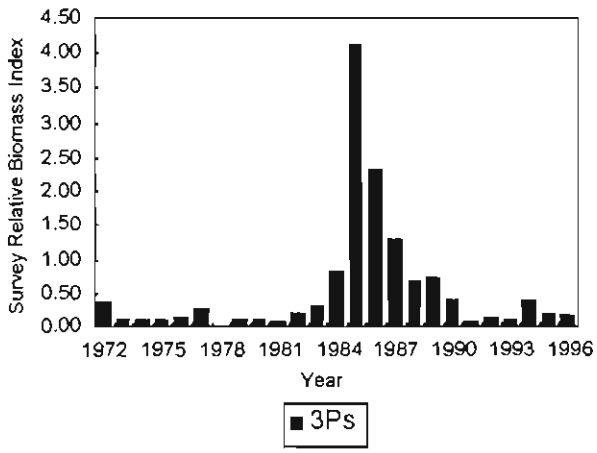
[1] Provisional
[2] By-catch Only
[+] Catch less than 500 metric tons

Catches since 1960 have been mainly in the 1,000 to 2,000 metric tons range, increasing to 7,500 metric tons in 1985 then falling below 1,000 metric tons after 1990. The increase in the mid-1980s was mainly due to increased effort by France. Provisional catch for 1995 is 42 metric tons which is the second lowest on record. This is partially due to the moratorium on cod established by Canada in 1993. Only 8 metric tons have been recorded to mid-August of 1996.



Resource Status

Research vessel surveys have been conducted by Canada since 1972. **Abundance and biomass** indices of haddock from these surveys were low from 1972 to 1982. Both indices peaked in 1985 due to the presence of the relatively strong 1981 year-class, but have since declined to low levels. The mean numbers and weights caught per tow were highest in 1985, but have since declined. Survey abundance at age indicate that **recent year-classes** are weak.



The level of **fishing mortality** for this stock is believed to have been high during the late 1980s. The moratorium on the cod fishery has reduced the by-catch of haddock.

Ecological Factors

Haddock in Newfoundland waters are thought to be at the northern extension of their range in the Northwest Atlantic. Cold waters throughout the area in recent years have probably been restrictive to their distribution, behaviour and early-stage survival. Temperatures appear to be moderating in 3Ps recently, and this may be favorable for haddock in the area.

Outlook

There have been no signs of improved recruitment in recent years and therefore is no prospect of the stock increasing in the near future.

Haddock in this area show considerable variation in recruitment but the mechanisms are not understood. The most recent good year-class (1981) was fished out before it reached spawning age.

For More Information

Research Document: Murphy, E.F. 1995. The Status of 2GH cod, 3LNO haddock, 3Ps haddock and 3Ps pollock. DFO Atl. Fish. Res. Doc. 95/33.

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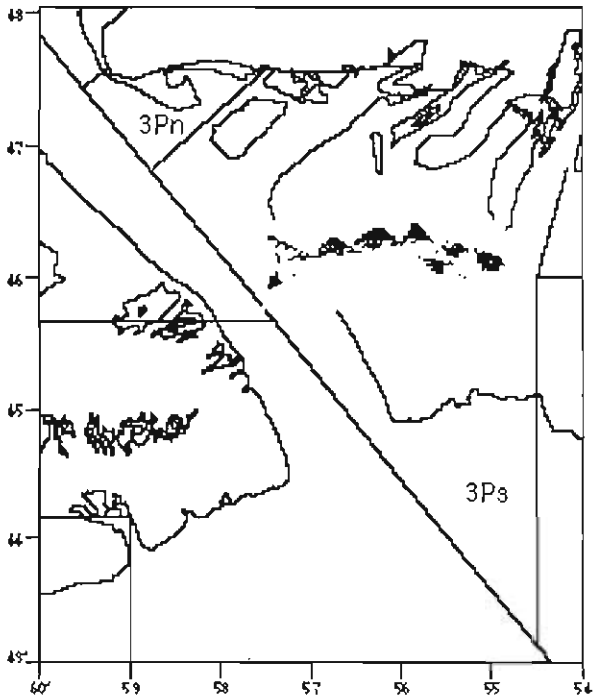
SUBDIVISION 3Ps POLLOCK

Background

Pollock occur on both sides of the North Atlantic; on the North American side from southern Labrador around Newfoundland into the Gulf of St. Lawrence, and south to Cape Hatteras. Pollock is a member of the cod family (Gadidae), but unlike most members spends little time near the bottom. They are voracious eaters and often congregate in large numbers. As pelagic larvae they feed mainly on copepods, but as they settle and move inshore, crustacea, mainly amphipods, are the preferred food. As they increase in size euphausiids, shrimp and small fish become part of the diet. In the offshore areas sand lance, herring, silver hake, redfish and lanternfish become more important in the diet.

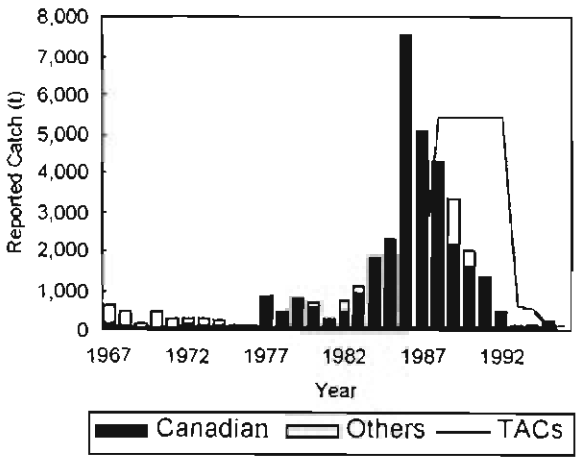
Pollock are a cold water fish preferring waters from 0° C to 10° C. However maturation of sex organs and incubation of eggs requires temperatures in the upper range. This fact places Newfoundland waters at the northern end of pollock range. Research on pollock in the Newfoundland area shows that mature fish occur along the slopes of St. Pierre Bank and the slopes of the southern Grand Bank. In summer months schools of young pollock are occasionally found in harbors along Newfoundland's south coast.

Pollock do not generally occur in Newfoundland waters in sufficient numbers to support a major commercial fishery.



The Fishery

Historically, catches of pollock in Subdivision 3Ps have been generally low and less than 1,000 metric tons annually from 1967-1982. Catches gradually increased however, peaking at 7,500 metric tons in 1986, but have since declined to pre-1980 levels. Less than 100 metric tons were caught in 1994, but catches more than doubled to about 250 metric tons in 1995. Preliminary data to August 14, 1996 indicates a catch of only 26 metric tons.



Landings (thousand metric tons)

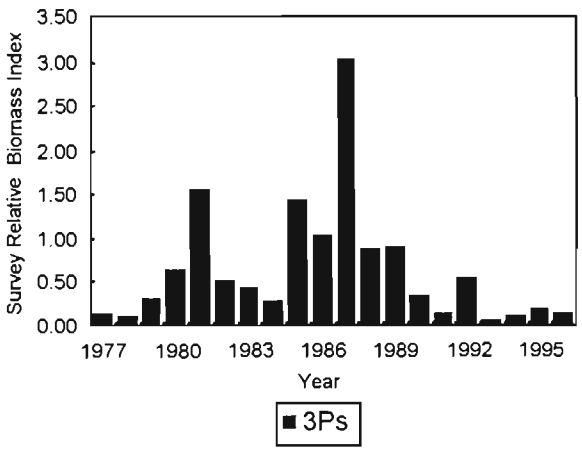
Year	67-76 Avg.	77-90 Avg.	1992	1993[1]	1994[1]	1995[1]	1996
TAC	-	-	5.4	.6[2]	.5[2]	.1[2]	.1[2]
Can.	.1	2	.5	.1	.1	.3	+
Others	.2	.2	0	0	0	0	
Totals	.3	2	.5	.1	.1	.3	

[1] Provisional
[2] By-catch Only
[+] Catch less than 500 metric tons

In 1996, by-catches of large commercial size pollock have increased significantly, and resulted in the fishery for hake in the offshore being closed.

Resource Status

Due to the pelagic nature of the species, **research vessel surveys** may not give a reliable index of abundance or biomass. However surveys have been conducted in NAFO Subdivision 3Ps since 1972 by Canada. The **relative biomass index** was low in the 1970s. It gradually increased to generally higher levels until 1989, but has since declined to pre-1980 levels.



Surveys in the 1990s have caught very few pollock.

In the spring of 1995, and again in 1996 schools of small pollock were observed in many south coast harbours. These small fish were not caught during the surveys in those years.

The origin of the large pollock being taken as by-catch in 1996 is unknown; they were not caught during the 1996 survey. It is likely that they have migrated to the area from further south.

Ecological Factors

Pollock in Newfoundland waters are at the northern extension of their range in the Northwest Atlantic. Cold waters throughout the area in recent years have probably been restrictive to their distribution and behaviour, although the presence of large fish in 1996 suggests some recent movement into the area.

Outlook

Pollock have never been a major component of the commercial fishery in NAFO Subdivision 3Ps. The fishery is opportunistic, and based on the occurrence and survival of year-classes against great odds in the extreme north of their range. There may also be occasional migration to the area from further south. Recent surveys show biomass and abundance are low for all sizes of pollock.

For More Information

Research Document: Murphy, E.F. 1995. The Status of 2GH cod, 3LNO haddock, 3Ps haddock and 3Ps pollock. DFO Atl. Fish. Res. Doc. 95/33.

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SUBDIVISION 3Ps
WITCH FLOUNDER

Background

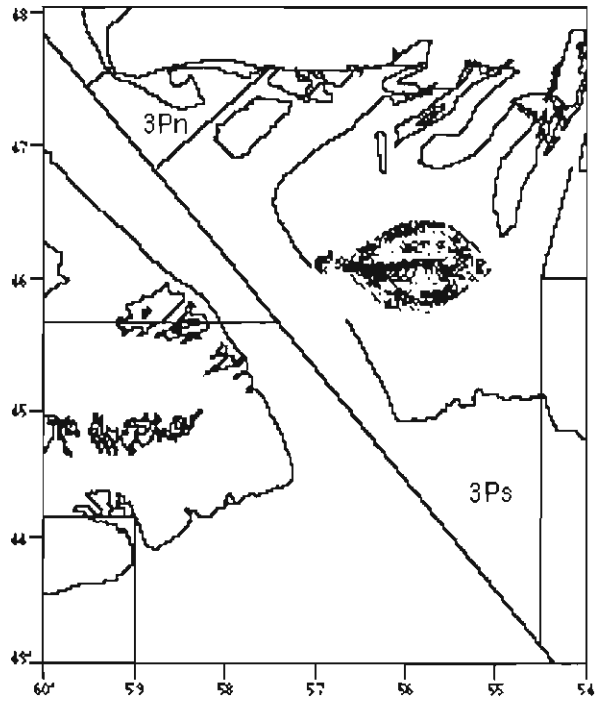
Witch flounder is a deepwater flatfish which reaches its northern limit in the Northwest Atlantic near Hamilton Bank off southern Labrador, but extends as far south as the east coast of the southern United States. Although traditionally it has been most abundant in depths of about 200–400 meters (109–219 fathoms), more recently it has been caught mainly in depths well in excess of 900 meters (492 fathoms). In Subdivision 3Ps, it is generally distributed along the slope of the continental shelf as well as in the mouth of Fortune Bay off Newfoundland's south coast.

It is a long–lived, slow growing species and has been aged to over 30 years old. However, the number of age groups comprising the witch flounder stock in Subdivision 3Ps has been reduced substantially since the mid-1970s when it was common to catch fish up to at least 20 years old. Fish older than 13 years are now rarely seen in either the commercial or survey catches.

About 50% of the males are mature at age 6.9 30 cm(12 inches)). Females don't mature until they are somewhat older; 50% are mature at ages 9.5 (40 cm(16 inches)).

Spawning occurs over a rather prolonged period usually extending from March through to September for most areas of the Northwest Atlantic, however in the Subdivision 3Ps area spawning takes place early by comparison, with highest intensity in the period January to March. During the winter and spring months it can be found in spawning concentrations along the continental slope of St. Pierre Bank at which time most commercial fishing operations occur and catch rates are generally highest.

The first quota was set at 3,000 metric tons in 1974. The TACs remained at this level through 1988. Since then they have been 1,000 metric tons annually until 1996 when it was reduced to 500 metric tons.



The Fishery

Catches of witch flounder in NAFO Subdivision 3Ps averaged about 1,000 metric tons annually during the 1960s. They increased to over 4,000 metric tons in 1967 to 1969, then declined slowly to former levels in the late 1970s. During the last 10 years catches ranged from 300 metric tons in 1983 to 1,300 metric tons in 1986. However, since 1989 the average catch has been about equal to the TAC of 1,000 metric tons with the exception of 1994 and 1995 when reported catches were only about 400 and 270 metric tons respectively.

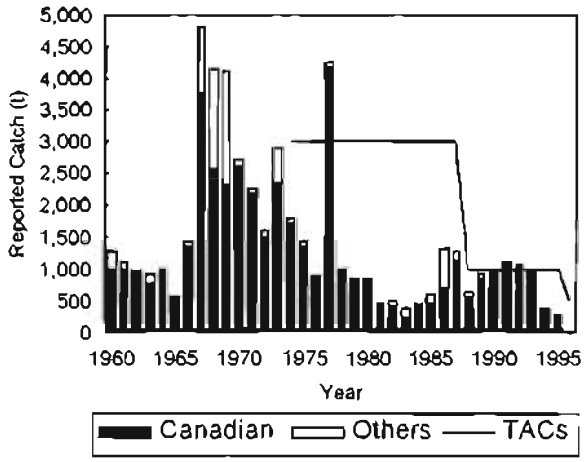
Landings (thousand metric tons)

Year	60-76 Avg.	77-90 Avg.	1992	1993[1]	1994[1]	1995[1]	1996
TAC	-	-	1	1	1	1	.5
Can.	2	.9	1	1	.4	.3	
Others	.4	.1	0	0	0	0	
Totals	2	1	1	1	.4	.3	

[1] Provisional

Catches from this stock have been taken mainly by Canadian trawlers fishing offshore on St. Pierre Bank while there are some catches taken by small vessels using Scottish seines and

gillnetters fishing in Fortune Bay off the south coast of Newfoundland. Prior to the boundary settlement between Canada and France, fishers from St. Pierre and Miquelon also caught small amounts of witch flounder (usually less than 100 metric tons annually) although this no longer appears to be the case.

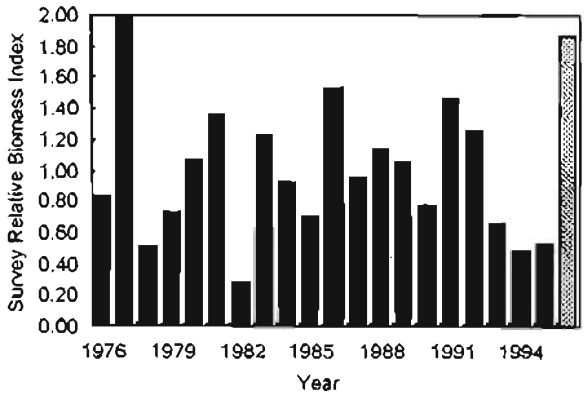


Fishing was conducted at the southeastern tip of St. Pierre Bank in depths ranging from 200 to 900 meters (110 to 492 fathoms) during 1993 and 1994. As a result of the closure of the American plaice and cod fisheries in Subdivision 3Ps combined with a 5% by-catch constraint, the 1994 fishery for witch flounder was seriously hampered and resulted in the lower than usual catch level. The reported offshore trawler catch for 1995 was only about 5 metric tons. This was due to excessive by-catch of American plaice which caused the witch fishery to be curtailed. The remainder of the reported catch (265 metric tons) was taken by vessels using Danish seines

Resource Status

Stratified-random research vessel surveys have been conducted annually by Canada on St. Pierre Bank since the early 1970s, however, only since about 1976 has coverage been relatively complete at least to a depth of 549 meters (300 fathoms). The **survey relative biomass index** has been highly variable over the past 15 years fluctuating between years, but showing little in the way of any trends.

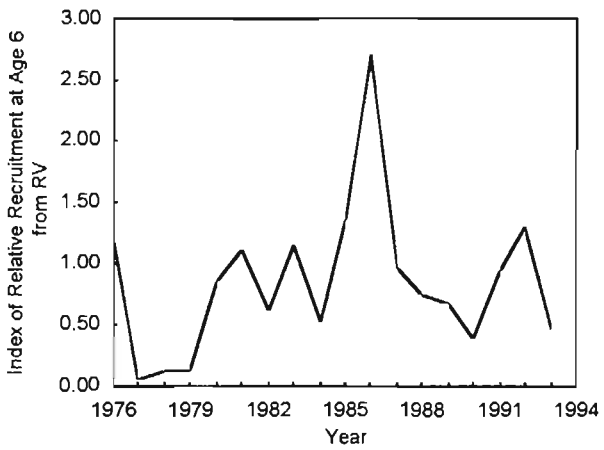
The survey conducted in 1996 was done using a new and more efficient survey trawl. Until acceptable conversion factors have been established between the gears, the 1996 result cannot and should not be put in the same context as those of previous years.



An examination of the survey catches by depth zone indicated that during the late 1970s and early 1980s there were considerable numbers of fish in depths less than 183 meters (100 fathoms) whereas during the 1990s there were none.

Survey results from 1993-95 were below average, but within the range of previous estimates. The commercial fisheries in 1993 and 1994 occurred in deep water beyond the survey area which would support the hypothesis that witch flounder are currently distributed in depths not surveyed by the research vessel. On the other hand, in both years the fishery was concentrated within a relatively small area on a pre-spawning concentration of high density. Therefore, the fishery may not be an indicator of a high level of biomass.

Information on age distribution is not available for the years since 1993. However, based on research survey information to 1993, **recruitment** has been at about the long term average in recent years.



Sources of Uncertainty

The main sources of uncertainty regarding the status of this stock may be summarized as follows: a) the only source of data regarding stock status is the research survey database which shows very little in the way of trends over time, b) the current survey coverage may not include all depths where witch flounder are distributed, and c) .because of the change in fishing gears, the 1996 survey results are presently not comparable with those from previous surveys.

Outlook

The survey biomass has been below average but relatively stable over the last few years while catches have been very low. Continued low catches are not likely to cause a decline in this stock.

For More Information

Research Document: Bowering, W.R. 1995. Witch flounder in NAFO Subdivision 3Ps: a stock status update. DFO Atl. Fish. Res. Doc. 95/38.

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BLACKBACK (WINTER) FLOUNDER IN DIVISIONS 3K, 3L AND 3Ps

Background

In the western north Atlantic, winter flounder (Pleuronectes americanus), commonly referred to as blackback, is locally abundant from southern Labrador to Georgia, inhabiting muddy to moderately hard bottoms. Throughout its range, it is known to migrate seasonally, moving away from the coast in the winter. At any time of year, around the coast of Newfoundland, it is generally not found in depths exceeding 40 m. In this shallow habitat, it is subject to a wide range of water temperatures and is capable of surviving sub-zero conditions.

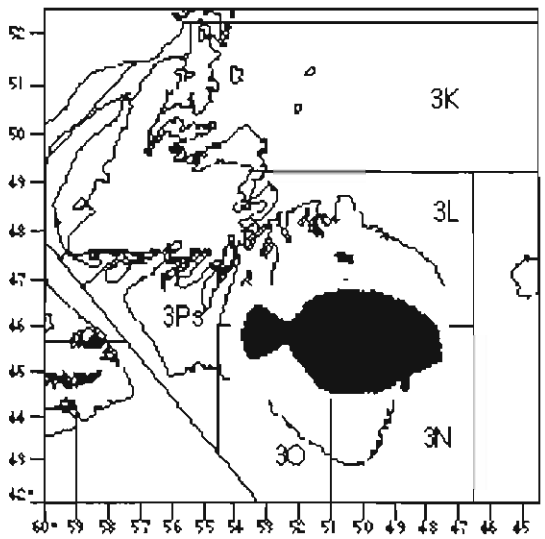
Spawning occurs in late winter or early spring. The females release several hundreds of thousands of eggs that settle to the bottom, adhering to rocks and vegetation. After hatching, the larvae drift in surface waters for several months before metamorphosing and settling to the bottom.

Growth rates vary among areas but little is known about the growth rates of winter flounder in Newfoundland waters.

It is an opportunistic feeder, taking a variety of benthic organisms, mainly mollusks and small crustaceans and also feeding on the eggs of other spawning fish.

Winter flounder has been taken locally around the coast of Newfoundland in NAFO divisions 3K, 3L, 3P and 4R with gillnets as lobster bait for years. The gillnet fishery has also supported limited food markets since the early 1970's, the product commonly referred to as lemon sole. On occasion in the past, experimental shallow water trawl fisheries have yielded reasonable catches. The flesh of winter flounder is of good quality and in northeastern U.S., it is valued as both a commercial and sport fish. With the closure of the cod fisheries in 1992 and 1993, attention has focused on this and other non-traditional species.

At present, fishing is not under quota control.



The Fishery

The fishing season for winter flounder is April 1 to December 31. The approved minimum and maximum mesh size for gillnets is 6.5 and 8.5 inches respectively. As for other flatfish, use of at least 7-7.5 inch mesh is encouraged.

Ten percent of the landings are monitored daily to determine by-catch of regulated species. This often results in closures because of higher than allowed by-catches.

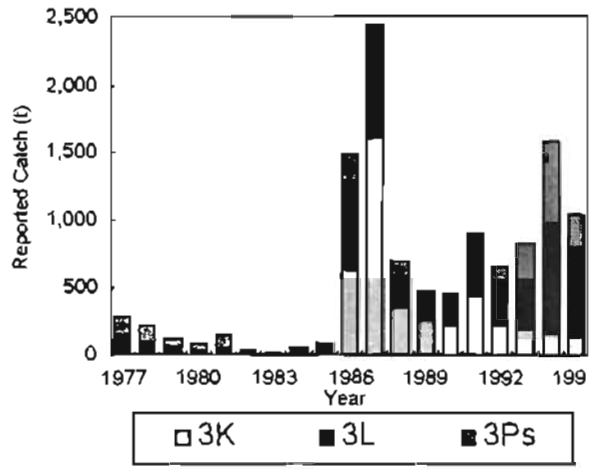
Landings (thousand metric tons)

Year	77-90 Avg.	1992	1993[1]	1994[1]	1995[1]	1996
Can	.5	.6	.8	1.6	1.0	

[1] Provisional

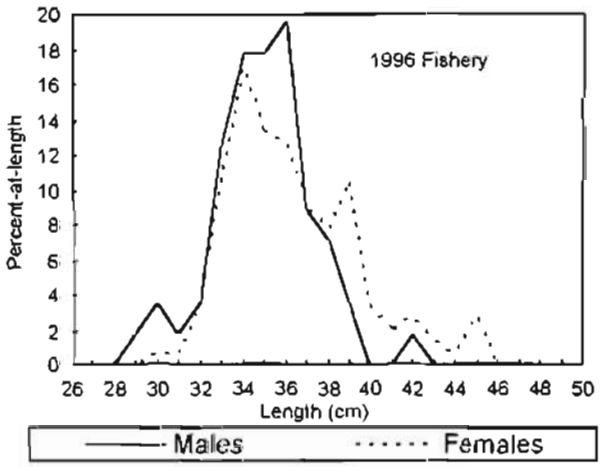
Reported landings, from NAFO divisions. 3K and 3L and Subdivision 3Ps are from a nearshore gillnet fishery. Prior to 1977, reported landings were less than 400 metric tons annually.

A substantial portion of the catch taken for lobster bait may be under-reported. As well, before 1986 blackback and American plaice landings were not differentiated and this likely explains the substantial increase in reported landings beginning in 1986.



The fishery was predominately in Division 3K in the late 1980s. Catch in this area declined to less than 10% of the combined landings in 3KLPs by 1994.

In 1996, for the first time, length frequency information was collected from the fishery. It showed mean lengths of males and females caught to be 35 and 36 cm (13.5 and 14 inches) respectively



Resource Status

Little is known about the species in the Newfoundland area. It is distributed close to the coast generally no deeper than 40m. As a result, it is seldom taken in research vessel survey trawls and no estimates of biomass are available. The only studies from this area pertain to feeding. The diet of blackback collected off eastern Newfoundland has been shown to be mainly sea urchins although it was noted that they are opportunistic feeders.

Sources of Uncertainty

Lack of data make it impossible to determine trends in the biomass and information on the general biology of this species around Newfoundland is limited. As well, the likelihood of significant unreported landings make it difficult to estimate removals. Until 1996, there were no data on sizes of the landed fish.

Outlook

This species has been taken in small quantities for many years. Although in recent years effort has increased, closures due to excessive by-catches of regulated species such as cod, pollock or haddock have tended to keep this fishery small. Given the good quality of the flesh coupled with increased interest in non-traditional species, fishing pressure could increase. Possible impacts on the resource cannot be evaluated with existing data.

For More Information

Research Document: Kulka, D.W., E. DeBlois and B. Davis. 1996. Non-traditional groundfish species on the Labrador Shelf and Grand Banks - wolffish, monkfish, white hake and winter (blackback) flounder. DFO Atl. Fish. Res. Doc 96/97.

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CATFISH (WOLFFISH) IN DIVISIONS 2J, 3K, 3L, 3N, 3O AND 3Ps

Background

The commercial catfish (or wolffish) in Newfoundland waters are made up of two different species; the Atlantic (or striped) catfish (Anarhichas lupus) and the spotted catfish (Anarhichas minor). Both species are found on both sides of the Atlantic Ocean. In the northwest Atlantic, they are distributed from Davis Strait to Maine.

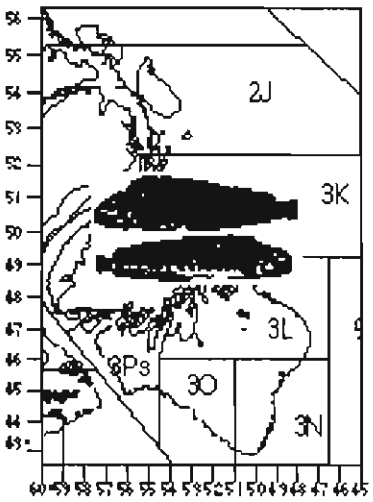
The spotted catfish inhabits deep waters to beyond 475 meters (260 fathoms) and temperatures of 3.1-4.0°C. The striped catfish is found further south in shallower depths (100-350 meters (55-191 fathoms)) and water temperatures as cold as 0.4°C. Tagging studies conducted on both species indicate little migration although there is some movement between deeper and shallower water by striped catfish. Neither species forms large schools.

Catfish in Newfoundland waters, especially spotted catfish, are presumed to grow slowly although information is limited. Both can grow to lengths greater than 100 cm (39 inches).

Striped catfish in Newfoundland waters spawn in September, and the entire larval stage is spent close to the location of hatching. Information on spotted catfish is more limited, but they appear to spawn in late autumn or early winter. Some information suggests that the larvae are pelagic.

The food of catfish includes a variety of bottom invertebrates as well as small amounts of fish. They will also feed on offal from fishing operations.

Catfish are taken as by-catch in trawler fisheries around Newfoundland. Currently the catches are unregulated.



The Fishery

In the Canadian offshore fisheries catfish have been taken only as by-catch. The two species together comprised the second most abundant by-catch in the trawler catches after skates. They have also been taken as by-catch in gillnets, and to a lesser extent on longlines.

Landings (thousand metric tons)

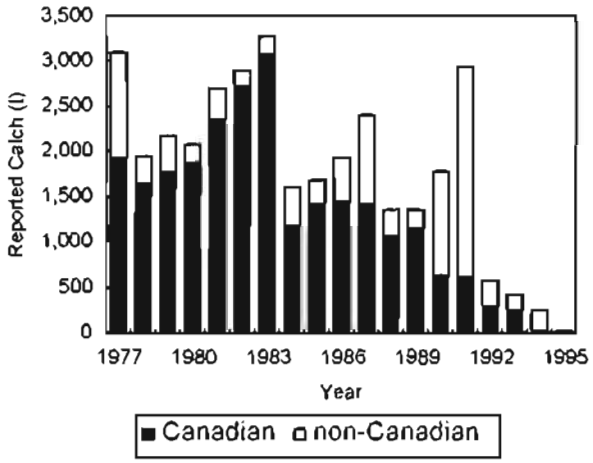
Year	77-90 Avg.	1992	1993[1]	1994[1]	1995[1]	1996
Can.	2	.3	.3	+	+	
Others	.5	.3	.3	.3	0	
Total	N/A	.6	.6	.3	+	

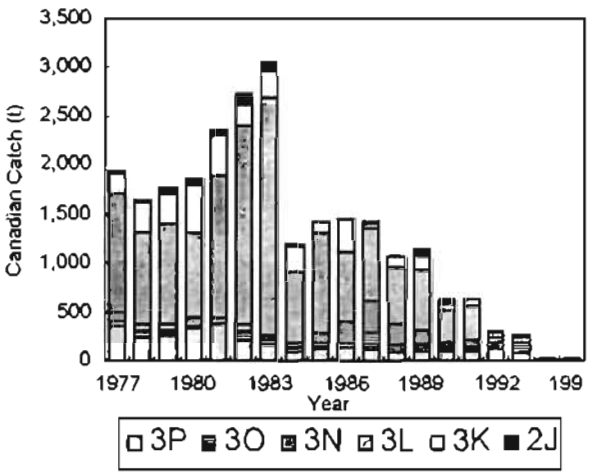
[1] Provisional
[+] Catch less than 500 metric tons

Canadian catches in divisions 2J3KLNO and Subdivision 3Ps exceeded 2,000 metric tons in only 3 years since extension of jurisdiction; 1981, 1982 and 1983. In all other years until 1989, catches were about 1,500 metric tons. After 1989 catches gradually declined to only 20 metric tons in 1995. These declines reflect the by-catch nature of this fishery. In most years, most of the catch was reported from 3L.

Non-Canadian catches exceeded 1,000 metric tons only in 1977, 1990 and 1991. In most other years, catches were less than 500 metric tons. Most of the catches in recent years were reported from outside 200 miles in divisions 3LNO, but in earlier years, when there were still

foreign allocations inside 200 miles, catches were higher in 2J and 3K. As with the Canadian fleets, non-Canadian catches are taken as by-catch in fisheries directed for other species.

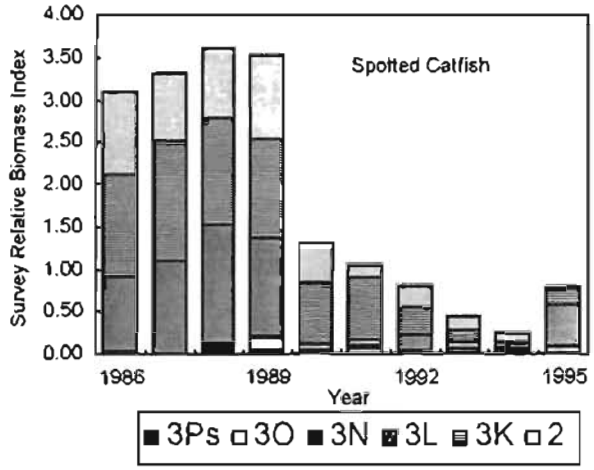


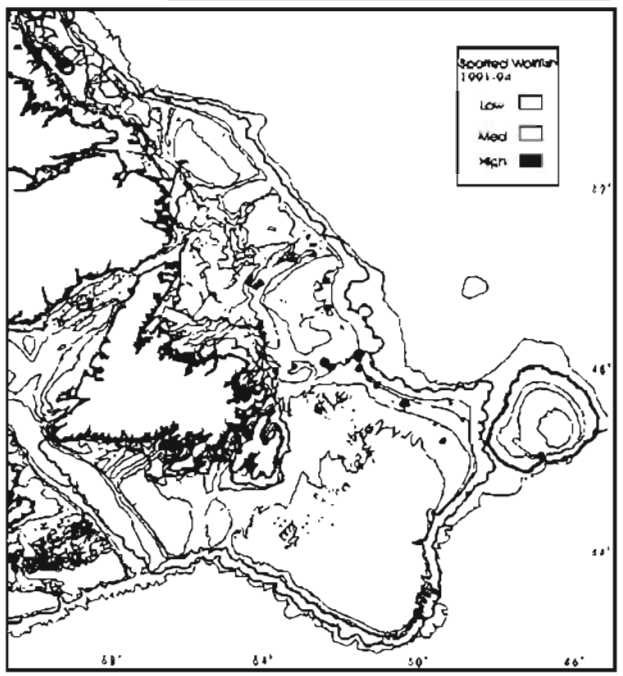


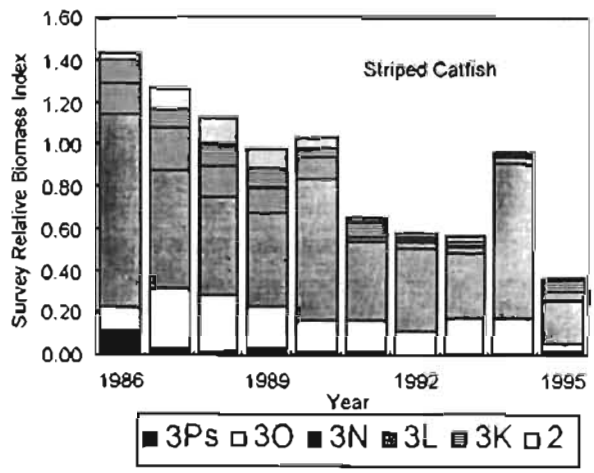
Resource Status

Little is known about catfish in Newfoundland waters except for results from **annual research surveys**.

Spotted catfish are primarily found in the more northern areas, and are relatively rare south of Division 3L. The survey data indicate a decline between 1989 and 1990, primarily in divisions 2J and 3L. There was some decline in 3K in that year, but further decline occurred later in this division.

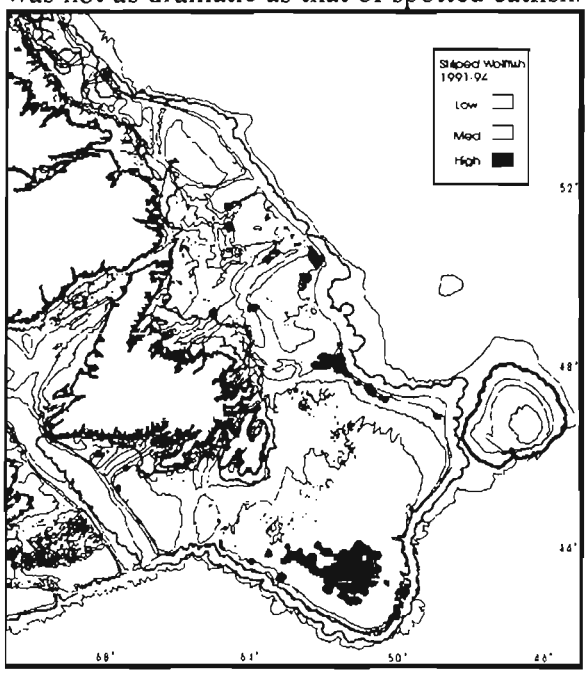






The survey results indicate that striped catfish are most abundant in Division 3N, followed by Division 3O. There was a gradual decline in the

biomass of this species from 1986 to 1995, but it was not as dramatic as that of spotted catfish.



Of particular interest is the persistent concentration in a small area of the southern Grand Banks which straddles the 3N-3O boundary.

Sources of Uncertainty

Very little is known about catfish in Newfoundland waters although it constituted the second largest by-catch in offshore fisheries through the 1980s. Age, growth, reproduction, mortality, movements and stock structure have not been examined extensively.

Outlook

Catfish catches have been restricted to by-catch historically. It is possible that the declines observed in the survey estimates are due to these by-catches. There are no indications of interest in any directed fishery at present.

For More Information

Research Document: Kulka, D.W., E. DeBlois and B. Davis. 1996. Non-traditional groundfish species on the Labrador Shelf and Grand Banks - wolffish, monkfish, white hake and winter (blackback) flounder. DFO Atl. Fish. Res. Doc. 96/97.

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LUMPFISH IN DIVISIONS 3K, 3L AND 3Ps

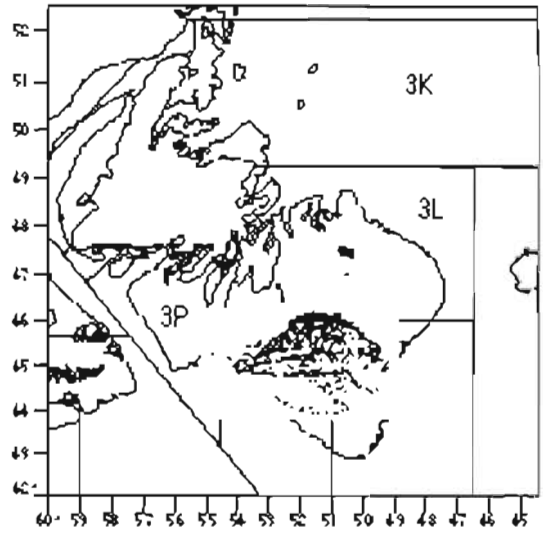
Background

Lumpfish (Cyclopterus lumpus) are found on both sides of the North Atlantic in cold to temperate coastal waters. They are primarily a bottom dwelling species but have been reported to be semi-pelagic during early life.

Spawning takes place during the spring in Newfoundland waters and continues into the summer. The preferred spawning grounds are shallow water rocky shores with abundant sea-weed growth. After the egg masses have been deposited, the females leave and the smaller, now reddish colored males, are left to guard them. Initially growth is relatively fast, with the fish doubling in length within one month. Length can range between 50 and 75 mm (2 to 3 inches) by the first year of age. Some data have shown that females continue to grow fast up to age 5 where they can reach a size of 30 cm (12 inches). After age 5 growth slows. Large females have been reported up to 60 cm (24 inches) and weighing almost 10 kg (18 pounds).

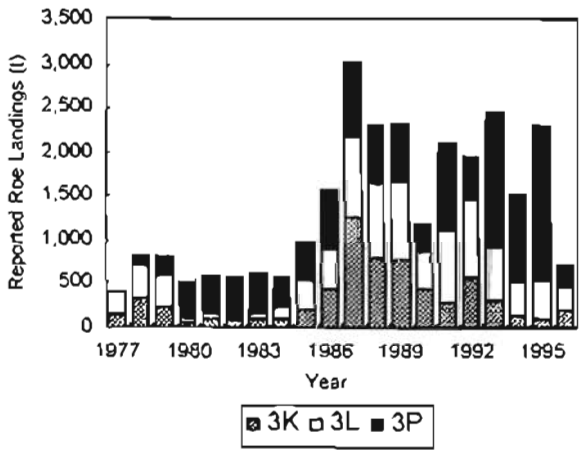
Lumpfish feed on a wide variety of invertebrates such as euphausiids, pelagic amphipods, copepods, other small crustaceans, jellyfish and some small fish such as herring and sand lance. Lumpfish are readily eaten by seals. They have also been found in stomachs of Greenland sharks.

The Canadian fishery for lumpfish started in the late 1960s and is primarily based on roe, the unfertilized eggs. Eighty percent of the landings are reported by vessels less than 35 feet.



The Fishery

The commercial fishery for lumpfish roe began in Newfoundland in 1969, developing slowly for the first number of years. Catches gradually increased to around 500 metric tons through 1984. For the next three years there was a doubling of the landings to a peak of 3,000 metric tons in 1987. Landings averaged 2,000 metric tons from 1988 to 1995.



Roe Landings (thousand metric tons)

Year	77-90 Avg.	1992	1993[1]	1994[1]	1995[1]	1996[1]
Can.[2]	1	2	2	2	2	7

[1] Provisional
[2] Management since 1992 through effort controls

There was a reduction in landings reported in 1996 to 700 metric tons; however these data are very preliminary .

The fishery was predominantly in Division 3K in the late 1980s. Catch in this area declined to less than 5% of the combined landings in divisions 3KLPs by 1995.

Resource Status

Research survey **indices of biomass** have been calculated separately for NAFO divisions 3K and 3L for 1981-1994 and 1981-1996 for Subdivision 3Ps. Fall survey estimates have fluctuated between years in divisions 3K and 3L, but have shown no trend over time.

In Subdivision 3Ps, the surveys have occurred at different times between January to June. Biomass estimates from the 3Ps surveys have declined an order of magnitude from 1985 to 1995. The biomass estimate for 1996 is the lowest since the early 1980s.

Inshore Fishery Improvement Committees have expressed concern over low catch rates along the northeast coast.

Conversations with fishers from Trinity bay have indicated catch rates of less than a lumpfish per net and many fishers stopped fishing before the end of the season.

Information from **marine study sites** (Memorial University) in Conception Bay has indicated a dramatic decrease in the number of lumpfish nests.

Port samplers in NAFO Subdivision 3Ps have reported catch rates at the lowest level since the fishery started in the 1970s .

Sources of Uncertainty

Growth rates, ages, natural mortality rates and productivity of this resource are all unknown. In addition, the stock structure of this species is not known and little work has been done to resolve this. Also, there is only limited information regarding migration patterns.

Outlook

The lumpfish fishery is exclusively on pre-spawning mature females and therefore the spawning stock is vulnerable to over-exploitation. Since the cod moratorium there has been an increase in fishers entering this fishery. Division 3K has displayed a decline in catch and catch rates. The 1996 catch from this area, although about double that of 1995 is still below the average of the 1990s. Also, it is unknown how much additional effort may have been exerted. In Subdivision 3Ps, survey indices have gone down since the mid-1980s and catch rates are at an all time low.

Overall, there is concern that the resource is declining, especially along the northeast coast. Steps should be taken to reduce effort and overall catches in order to halt the decline and allow for rebuilding.

Other conservation measures such as closure of portions of the spawning areas should also be considered.

For More Information

Research Document: Hoenig, J.M. 1995. What can we learn about lumpfish mortality from sex ratio data? DFO Atl. Res. Doc. 95/62.

Myers, R.A. and B. Sjare. 1995. An analysis of lumpfish from data on individual fishermen. DFO Atl. Res. Doc. 95/66.

Stansbury, D.E., E.F. Murphy and C.A. Bishop. 1995. An update of the stock status of 3KLP lumpfish. DFO Atl. Res. Doc. 95/65.

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MONKFISH IN DIVISIONS 3L, 3N, 3O AND 3Ps

Background

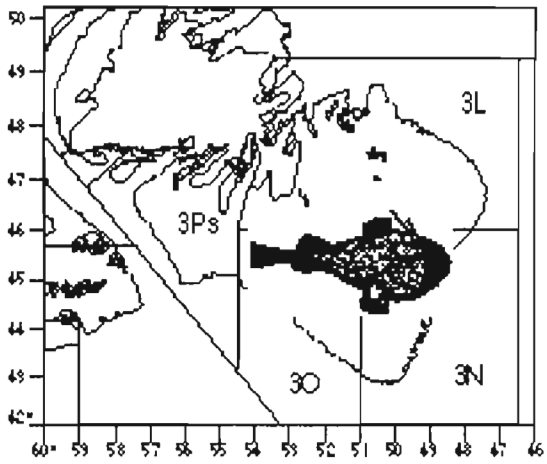
The monkfish or goosefish (Lophius americanus) is a bottom dwelling sluggish fish that lives in relatively warm waters. In the western Atlantic it is found around the Grand Banks, throughout the Gulf of St. Lawrence, on the Scotian Shelf and in the Bay of Fundy, and further south to northern Florida. It has been found in depths from the tideline down to about 650 meters (355 fathoms), and in temperatures from 0-21°C. Limited studies have indicated a seasonal migration to shallower water in summer and deeper water in winter.

Spawning is thought to occur from June to September in Canadian waters, with the larvae floating to the surface after hatching, the settling to the bottom as post-larvae.

Limited information on growth suggests they reach a length of about 11 cm (3 inches) at age 1, and a lengths of about 76 cm (30 inches) and 102 cm (40 inches) at ages 7 and 10 respectively.

Monkfish are voracious predators, consuming a wide variety of prey; both fish and invertebrates. The fishing 'lure' on its head serves as an attraction to prey.

Until recently, monkfish were taken only as by-catch in 3LNOPs, but with the decline in other resources, interest in a directed fishery has increased. The 1996 quota for 3LNOPs, 200 metric tons was set arbitrarily. It is allocated to fixed gear fisheries only.



The Fishery

Canadian catches, since extension of jurisdiction in 1997, remained less than 200 metric tons annually until 1991. During that period all landings were by-catch. In 1991 a directed trawl fishery began, and almost 400 metric tons were taken. Catches gradually increased with the development of this directed fishery to about 1,000 metric tons in 1994. The 1995 catch fell to only 165 metric tons under a quota restriction of 200 metric tons. A total of 213 metric tons has been taken in 1996 to August 14. The 1996 fishery is now closed because the 200 metric ton quota was reached.

Landings (thousand metric tons)

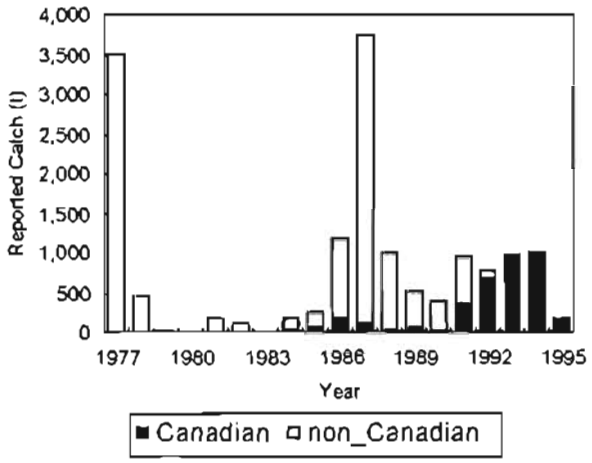
Year	77-90 Avg.	1992	1993[1]	1994[1]	1995[1]	1996
TAC					.2	.2
Can.	+	.7	1	1	.2	
Others	.8	+	+	+	+	
Total	N/A	.7	1	1	.2	

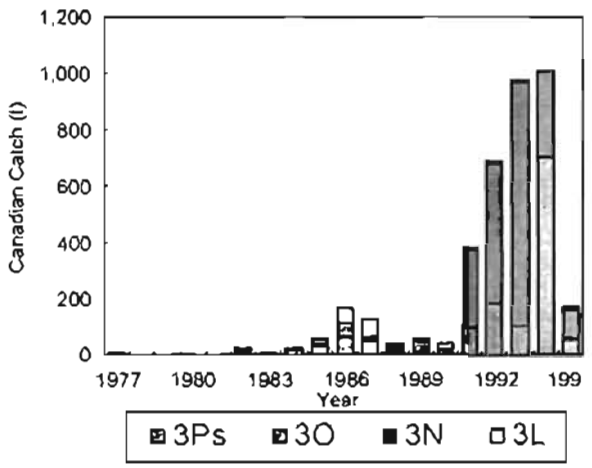
[1] Provisional
[+] Catch less than 500 metric tons

Canadian catches have come predominantly from Division 3O and Subdivision 3Ps. In 1993, 86% was reported from 3O, while in 1994, 70% was from 3Ps. Similar amounts were taken in total in both years.

Lengths caught during the 1996 fishery ranged between 51-114 cm (20-45 inches) with an average of about 81 cm (32 inches).

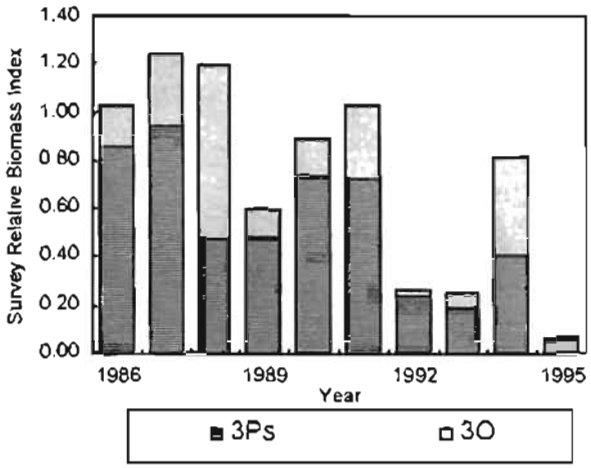
Non-Canadian catches have generally been less that 1,000 metric tons annually although it was reported that about 3,500 metric tons were taken in 1977 and again in 1987. It is possible that the 1987 figure may be inflated due to misreporting Most of the non-Canadian catches have been from Division 3N. In some years, reported non-Canadian catches from 3L exceeded 100 metric tons.





Resource Status

The only information available for monkfish in this area comes from research surveys. The **survey relative biomass indices** for the different areas clearly indicate that most monkfish are found in Division 3O and Subdivision 3Ps. Prior to 1992, the overall estimates remained fairly stable, but a decline was noted beginning in 1992, although there was a high estimate in 1994.



Although fisheries data indicate that catches have been taken in both divisions 3L and 3N, the research surveys from 1986 to the present have not found any monkfish in 3L, and very few in 3N.

Sources of Uncertainty

Monkfish are not caught in great abundance during the research surveys and have not been routinely studied Growth rates, ages, maturity, fecundity, movements and stock structure are all unknown.

Outlook

The status of monkfish in 3LNOPs is difficult to evaluate based on current analyses of existing data. Survey information does indicate declines both in biomass and mean size of the fish. It would therefore be prudent to maintain existing precautionary TACs.

For More Information

Research Document: Kulka, D.W., E. DeBlois and B. Davis. 1996. Non-traditional groundfish species on the Labrador Shelf and Grand Banks - wolffish, monkfish, white hake and winter (blackback) flounder. DFO Atl. Fish. Res. Doc. 96/97.

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DIVISIONS 3L, 3N, 3O AND 3Ps SKATES

Background

There are some 8 to 10 different species of skate in the waters around Newfoundland. Of these, the thorny skate (Raja radiata) is by far the most common, comprising greater than 90% of those caught during research surveys. The second most common are the smooth skate (Raja senta) and spinytail skate (Raja spinicauda). Although data on skate are routinely collected during research surveys, there has been only limited examination of these data. Most of the work to date has been done on thorny skate.

Thorny skate is widely distributed in the waters around Newfoundland being found in depths ranging from about 18 meters (10 fathoms) to over 1500 meters (735 fathoms), in temperatures from -1.4°C to about 14°C, and on both hard and soft bottoms. Tagging information suggests that they are sedentary species and generally do not undergo long migrations, moving less than 100 kilometers during their lives.

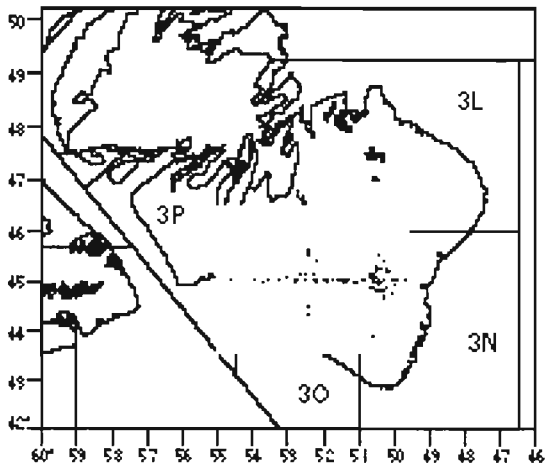
It is not known how long thorny skate live in the waters around Newfoundland. The time between tagging and recapture of some individuals, suggests that they can live at least 20 years. They deposit egg cases, perhaps better known as mermaids' or sailors' purses, inside of which are single embryos. Skates only lay between 6 and 40 of these a year. Males mature at smaller sizes than females, and size of maturity increases from north to south. Limited data suggest that reproduction occurs year round on the Grand Banks.

Thorny skate feed on a wide variety of items including both invertebrates and fish. As well, significant amounts of offal have been found in the stomachs of skate captured in the vicinity of commercial fisheries.

There has been only limited interest in fishing for skate in the waters around Newfoundland and skates were usually discarded although they constituted the most common non-commercial by-catch in offshore trawler catches. These by-catches were unreported and do not appear in catch statistics information. Most of the reported catches have been by non-Canadian fleets.

With the decline of other groundfish resources, Canadian interest in skates increased, and quotas were first put in place for 1995 inside Canada's 200 mile limit. The quota was set based on a 20% exploitation rate of the survey biomass estimate for 1993. This resulted in quotas of 5,000 metric tons for the Grand Banks (3LNO), and 1,000 metric tons for St. Pierre Bank (3Ps).

Fishermen are interested in the width of the skate wing, as the wing is the product. Based on market conditions, the minimum acceptable size is about 46 cm. (18 inches).



The Fishery

Because of little interest in skate when other groundfish stocks were healthy, catches reported to NAFO from the time of extension of jurisdiction averaged less than 5,000 metric tons until 1985 when the reported catches from Division 3N increased significantly.

Reported Landings (thousand metric tons)

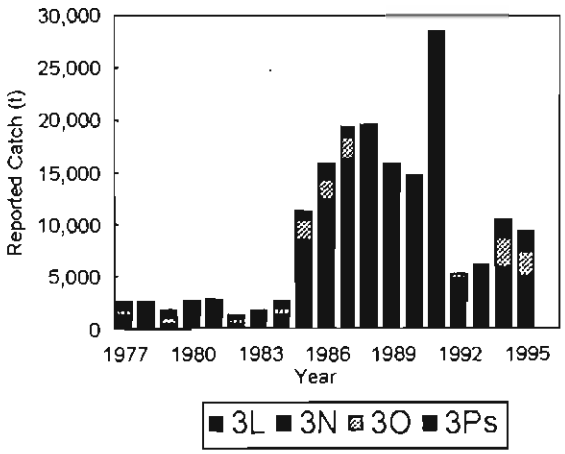
Year	77-84 Avg.	85-91 Avg.	1992	1993[1]	1994[1]	1995[1]	1996
TAC						6[2]	2[2]
Can.	.6	.1	.1	.1	3	5	
Others	2	18	5	6	7	3	
Totals	2	18	6	6	10	8	

[1] Provisional
[2] for Canadian waters only

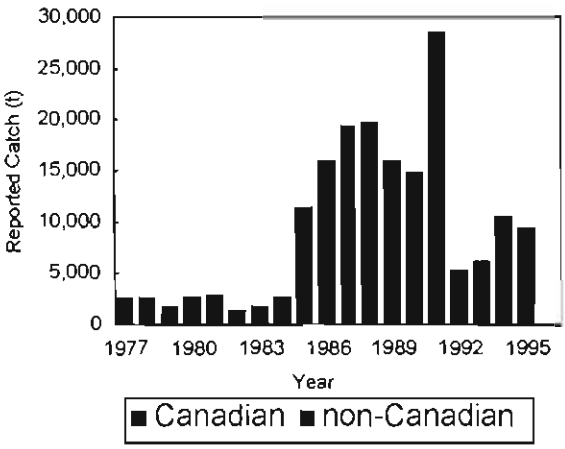
The increases in that year, which continued during the last half of the 1980s, were due to increased reported catches from outside 200 miles. Canadian surveillance has determined that some of these catches during the 1980s, reported as skates, may have actually been other species such as flatfish or cod. During the 1990s however, Canadian surveillance estimated catches outside 200 miles to be higher than those reported.

Also, reported Canadian catches are thought to be higher than actual because of the conversion factor between wing weight and round weight used by Statistics Branch. In the past, a conversion of 4 was used whereas more recent work indicates that a conversion of 3 is more appropriate. Steps are currently being taken to correct this.

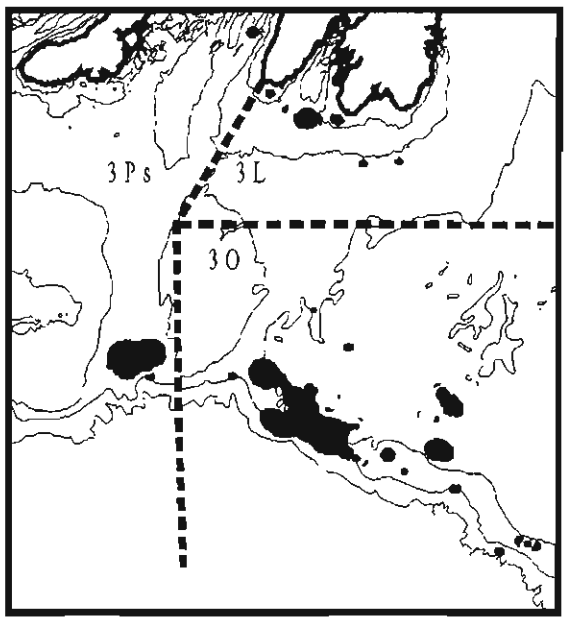
Based on observer data, unreported discards averaged somewhat less than 3,000 metric tons annually during the early- to mid-1980s in the 3LNO area. Estimates from the more recent period are unavailable.



Reported non-Canadian catches declined dramatically after 1991, and were estimated to be only about 2,600 metric tons in 1995.



Reported Canadian catches increased from about 100 metric tons in 1993 to about 2,700 metric tons in 1994 then 4,400 metric tons in 1995. Observer data (see map) indicate that the fishery was concentrated in a small area of western 3O and eastern 3Ps during these years.



The quota for 1996 was lowered to 2,000 metric tons based on the recommendation of the FRCC.

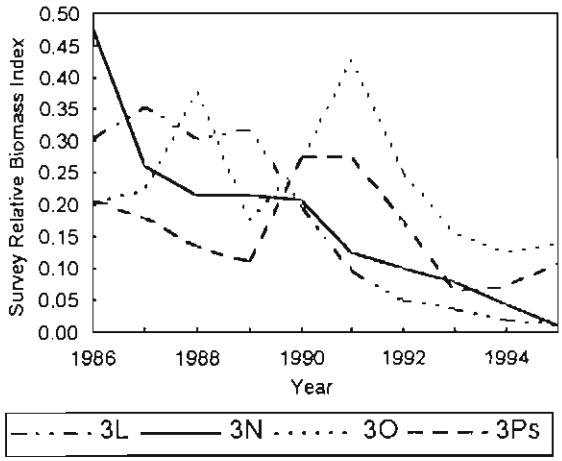
Steps were also taken in 1996 to spread fishing effort throughout the management area so as to minimize negative effects of concentrating it in any one area. This too was based on the recommendation of the FRCC. Separate quotas were put in place as follows: 3L - 200 metric tons, 3N - 400 metric tons, 3O - 900 metric tons, and 3Ps - 500 metric tons. These divisional allocations were based on biomass distribution observed during the 1992 to 1994 research surveys.

Preliminary data to mid-August 1996 indicate a catch of about 1,500 metric tons, with about 1,100 metric tons being taken in 3O and most of the remained in 3Ps.

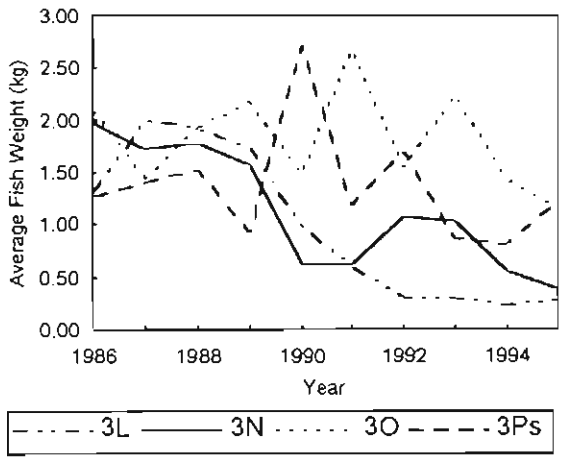
Resource Status

Research survey indices of relative biomass, calculated separately for NAFO divisions 3L, 3N, 3O and 3Ps for the period 1986 to 1995 indicate that the **biomass** of thorny skate in Division 3O and Subdivision 3Ps remained relatively stable until the early 1990s, but then declined. The survey indices declined steadily in

divisions 3L and 3N over the 1986 to 1995 time period, possibly as a result of the high catches outside 200 miles during the second half of the 1980s. Overall, trends in the survey estimates appear similar for 3L and 3N, and 3O and 3Ps but are different between these two areas.



Related to these overall declines, based on research survey data, the **average size** of the skate in divisions 3LN has also been declining quite dramatically over the time period examined. There were also some recent declines in Subdivision 3Ps although this was reversed in 1995. The mean size declined in Division 3O between 1993 and 1994 then again somewhat in 1995.



Based on sampling carried out from 1947 to 1972, females are larger at maturity in 3OPs than in 3LN. While about 50% of female skates with a wing width of 46 cm. (18 inches) are mature in divisions 3LN, only about 20% of the females in 3O and 3Ps are mature at that size. In 3O and 3Ps, about 50% are mature when the wing width is 56 cm. (22 inches).

Sources of Uncertainty

There are a number of important limitations to our knowledge of skates in the waters around Newfoundland. We lack information on such things as growth rates and age-of-maturity, as well as details of the age-or size structure of the population(s).

Assuming skates are a renewable resource, one would expect some evidence of renewal, some sign that skates that are caught are somehow replaced by fresh stock. Such evidence is lacking: the apparent decrease in survey biomass comes so close to matching the cumulative reported catches that it is not possible to establish a positive lower bound on the production of the stock.

It is also not possible, with available data, to determine the stock structure of the resource or the most appropriate exploitation rate for a sustainable fishery.

The first TAC (6,000 metric tons), imposed for 1995, was set at 20% of the 1993 survey biomass estimate. For skates, which have a very low reproductive rate, exploitation at 20% is excessive. However, because survey estimates do not represent the true total biomass, but only some portion of it, the actual exploitation would be somewhat lower. Because catchability is unknown, how much lower cannot be determined.

The 1996 recommended TAC of 2,000 metric tons represented approximately 10% of the 1994 survey estimate. This is a more conservative approach but nonetheless, similar uncertainty exists because of the factors noted above.

There are indications that catch information from the area outside 200 miles continues to be unreliable. Discarding inside 200 miles for the period since 1985 still remains to be quantified.

Outlook

It appears that the relatively high catches (including unestimated discards) of skate, particularly outside 200 miles are continuing to contribute to the decline of the resource in divisions 3LN. Catches of skates outside 200 miles remain unregulated.

Catches, both reported as well as discards, do not seem to have affected the resource in 3O and 3Ps to the same extent during the same period as they were relatively low, although the reasons for the declines in the survey estimates between 1991 and 1993 are unclear.

Analysis of research data suggests that different trends have occurred in divisions 3LN compared to areas further west. In addition, rates of maturity appear to be different in the two areas. Thus, it would be **prudent to consider divisions 3LN as one management area, and Division 3O as another.** Based on recent trends in the biomass index, **Subdivision 3Ps should possibly be managed as yet another.**

Applying a similar exploitation rate as was used in 1994 to the 1995 research survey estimates (10%) gives an estimate of about 2,500 metric tons. Of this, about 15% would be in 3LN, 50% in 3O and 35% in 3Ps.

Information currently available indicates that skates are fairly sedentary; that is, they don't move around much. Because of this, it can be relatively easy to deplete local concentrations. Therefore it is important that management continue to ensure that effort is not concentrated in any one area, but is spread out amongst different concentrations.

For More Information

Research Document: Kulka, D.W., D.B. Atkinson and E. DeBlois. 1996. Non-traditional groundfish species on the Labrador Shelf and Grand Banks - skate. DFO Atl. Fish. Res. Doc. 96/98.

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WHITE HAKE IN DIVISIONS 3L, 3N, 3O AND 3Ps

Background

White hake (Urophycis tenuis) belongs to the gadoid or cod family of fishes. They are found in the Northwest Atlantic from Cape Hatteras in the south to the Gulf of St. Lawrence, Grand Banks, and off southern Labrador. The areas of greatest abundance are the southern Gulf of St. Lawrence, Scotian Shelf and southwestern Grand Banks.

Young white hake are pelagic, and do not move to the bottom until they are 8-13 cm (3-5 inches) in length. They occur over a wide range of depths from 200-1000 meters (109-492 fathoms), and tolerate water temperatures from just above 0°C to 21°C although preferring 5-11°C.

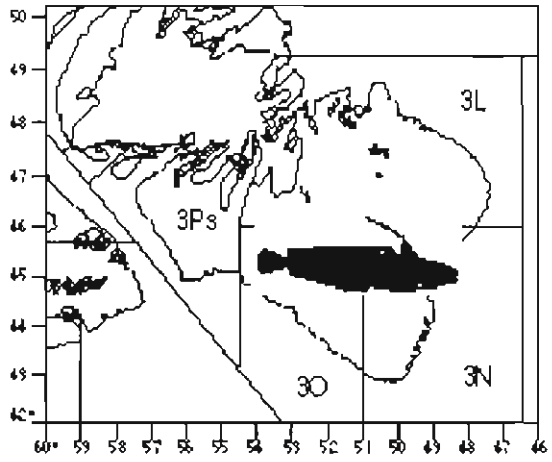
White hake are relatively fast growing, reaching about 53 cm (21 inches) by age 5, and 75 cm (30 inches) by age 10. They can reach a very large size; females of greater than 130 cm (51 inches) have been captured.

These fish spawn at different times in different areas. The time of spawning in the Grand Banks area is believed to be in mid-summer, and available evidence indicates that males mature at a smaller size (about 40 cm (16 inches) than females (about 47 cm (19 inches)). White hake are thought to perhaps be the most productive of the commercially exploited groundfish species in the Northwest Atlantic based on egg production.

White hake feed on a variety of prey items including large and small crustaceans, copepods, small fish and squid. Fish seems to be the most important prey of larger fish.

White hake is often difficult to distinguish from red hake. However, red hake is primarily found on the Scotian Shelf and it is doubtful that any are caught in Newfoundland waters.

Until recently, white hake was mainly taken as a by-catch in other fisheries in the 3LNOPs area. With the decline of the more traditional groundfish species however, interest in directed fisheries for white hake has increased. Currently there are no catch limits for white hake although by-catches of other species during directed hake fisheries are tightly controlled.



The Fishery

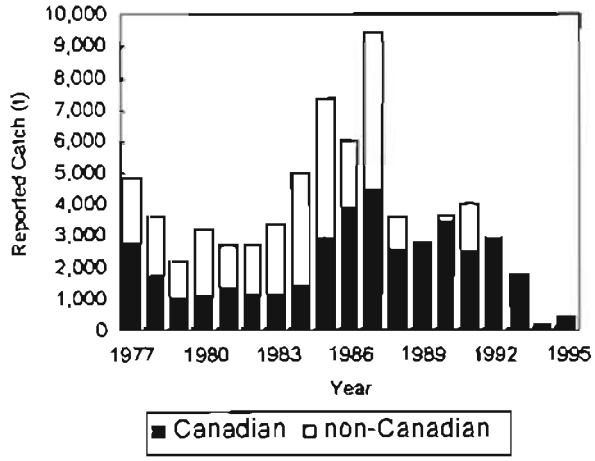
From the time of extension of jurisdiction until 1994, Canadian catches ranged between about 1,000 and 4,000 metric tons, averaging about 2,000 metric tons annually. Until 1993 it was taken only as by-catch in gill nets and longlines. In most years, the majority of the catches were taken in Division 3O and Subdivision 3Ps, although about 1,000 metric tons were taken in 3L in each of 1987, 1988 and 1989. Experimental trawl fisheries began in 1993, but catches dropped dramatically in 1994 and 1995 due to high cod and haddock by-catches.

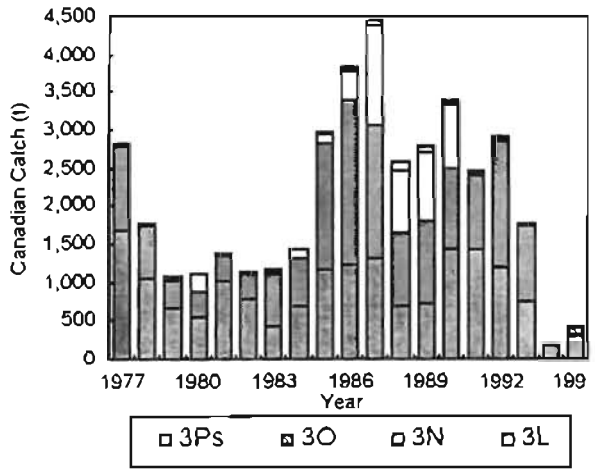
Landings (thousand metric tons)

Year	77-90 Avg.	1992	1993[1]	1994[1]	1995[1]	1996
Can.	2	3	2	.2	.4	
Others	2	0	0	+	0	
Total	N/A	3	2	.2	.4	

[1] Provisional
[+] Catch less than 500 metric tons

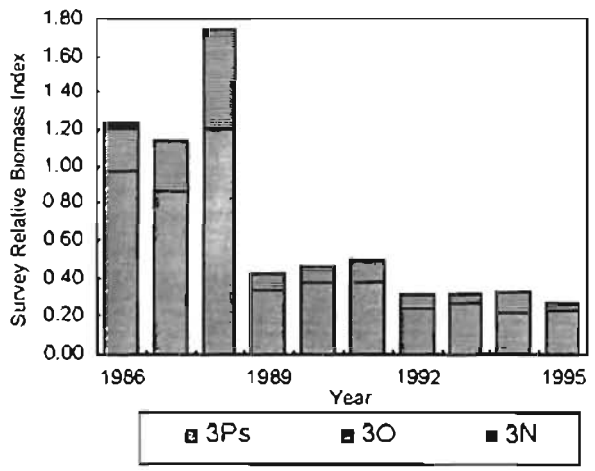
Non-Canadian catches also averaged about 2,000 metric tons annually after extension of jurisdiction, but catches were taken in divisions 3N and 3O. There may have been some misreporting during the second half of the 1980s. Annual reported catches declined to less than 100 metric tons annually after 1988 except for 1991 when 1,500 metric tons were reported.





During the 1996 fishery, white hake have averaged 69 cm (27 inches) in 3O, and 26 inches in 3Ps.

Resource Status



There is very little known about white hake in the 3LNOPs area as they have not been routinely studied. Research survey **indices of relative biomass** indicate that most are found in Division 3O and Subdivision 3Ps, with more being present in 3Ps. High estimates were obtained in 1986-1989, but there was a subsequent drop in both areas to a lower level in 1989. Since then, estimates have fluctuated in 3O with some indication of decline in 3Ps. It is possible that white hake are distributed deeper than depths covered by the surveys

Sources of Uncertainty

The drop in biomass suggested by the surveys between 1988 and 1989 cannot be explained at present. Information on stock structure, growth, mortality and movements are also lacking.

There are indications that hake caught in Newfoundland waters and classified as red hake are actually white hake since red hake are primarily found on the Scotian Shelf.

Outlook

The white hake fishery has mainly been as by-catches in the past. Since closure of many of the traditional fisheries in the area, more directed effort has been exerted, but catches have remained below historical averages due to problems with by-catch of other species Since then, the estimates have been relatively stable. During this most recent period, catches averaged about 2,500 metric tons. It is perhaps reasonable to believe that the directed fishery could be expanded to this catch level. Care must continue however, with regard to by-catches of other species during any expanded white hake fishery

The fishery for white hake is becoming more important to Newfoundland fishers It is important that adequate information be collected during any fishery so as to enable better evaluation of this resource in the future.

For More Information

Research Document: Kulka, D.W., E. DeBlois and B. Davis. 1996. Non-traditional groundfish

species on the Labrador Shelf and Grand Banks - wolffish, monkfish, white hake and winter (blackback) flounder. DFO Atl. Fish. Res. Doc. 96/97.

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STOCK STATUS REPORT NEWFOUNDLAND AND LABRADOR SNOW CRAB

Background

Snow crab, Chionoecetes opilio, occur over a broad depth range in the Northwest Atlantic from Greenland to the Gulf of Maine. In Newfoundland and Labrador there are no known barriers to larval drift or settlement, or other evidence to indicate distinct stocks. The preferred bottom type of adults is mud or mud/sand while juvenile crabs appear to favour gravel or small rocks. The snow crab diet includes clams, polychaete worms, brittle stars and other crustaceans. Predators include seals, cod, thorny skate, and other snow crabs.

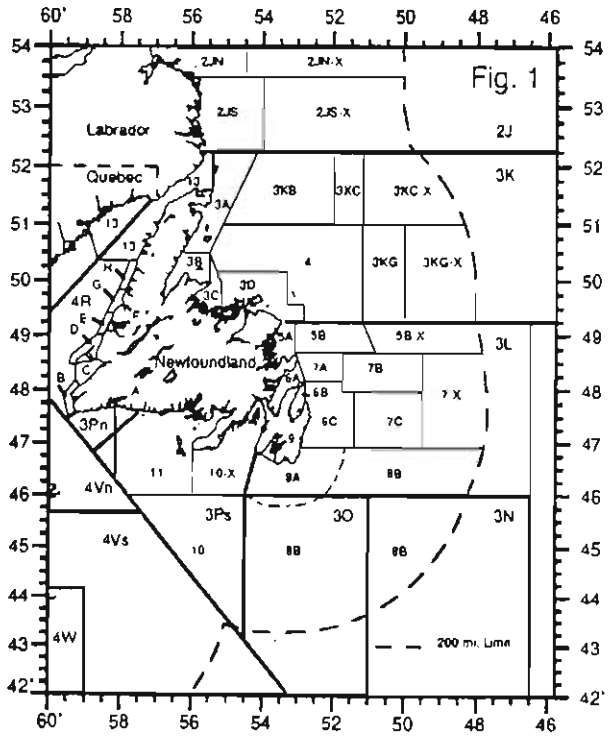
Males continue to molt until they develop large claws, which enhances their ability to compete for mates. This happens during a final molt which may occur over a wide size range, (50-110 mm carapace width, CW). Females cease molting when they mature, at relatively small sizes (40-75 mm CW). It is believed that these crabs live no more than 5-6 years after the final molt.

The minimum legal size in the fishery is 95 mm CW. This regulation excludes females from the fishery while ensuring adequate numbers of sexually mature males in the population for reproduction.

The Newfoundland fishery began in Trinity Bay in 1968. Initially, crabs were taken as gillnet by-catch but within several years there was a directed trap fishery in inshore areas along the northeast coast of the Island. Until the early 1980's the fishery was prosecuted by approximately 50 vessels, limited to 800 traps each. In 1981 fishing was restricted to the NAFO Division where the licence holder resided. In the mid 1980's there was a large decline in catches in traditional areas in 3K and 3L while at the same time fisheries started in 2J, 3Ps, 4R and offshore 3K.

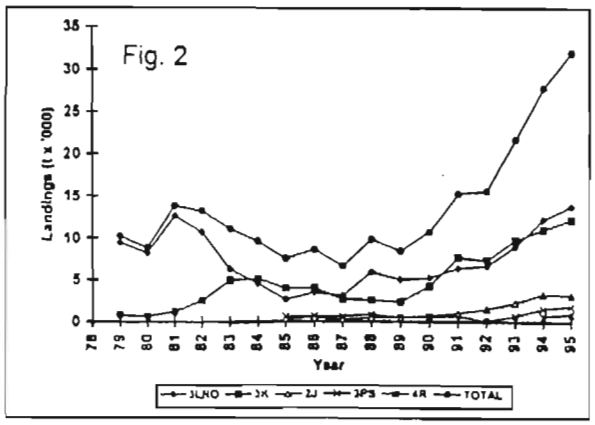
Since 1989 there has been a further expansion in the offshore. Fisheries supplemental to the groundfishery started in 3K in 1985, in 3L in 1987 and in both areas of 2J in the early 1990's.

In the late 1980's quota control was initiated in all management areas of each Division and fishing seasons for both fleet sectors were redefined. A dockside monitoring program designed and managed by fishers to enforce daily and weekly quotas was initiated in 3K in 1994 and expanded to include 2J, 3L and 3Ps in 1995. Temporary permits for small vessels (< 35 ft) were introduced in 1995 all around the island. There are now four fleet sectors: fulltime; supplementary >40 gross tons; supplementary <40 gross tons; and temporary, <35 ft vessels restricted to nearshore areas. All sectors have designated trap limits, quotas and fishing areas. Management areas (Fig. 1) do not reflect stock structure. Rather, they were established as a mechanism to control the distribution of fishing effort and prevent local over-exploitation.



The Fishery

Landings have been increasing steadily since the late 1980's and reached a record high of 32,000 t in 1995, more than double the historical peak in 1981 (Fig. 2). The bulk of the increased landings came from Div. 3K and 3L and largely from expansion of the fishery to offshore areas. Effort, as indicated by estimated trap hauls, has approximately doubled since the late 1980's. Recent catch rate patterns have been quite variable between management areas, but levels have remained high in most offshore areas of 3K and 3L. In certain inshore areas, where catch rates tend to be lower, there have been declines.



Div. 2J: Landings have continued to increase and reached 3,178 t in 1995, up from 2,978 t in 1994 (Table 1); effort continued to increase as well (by ~36%). The overall catch rate has been declining from a high in 1991 of 14.6 kg/trap haul to 7.9 kg/trap haul in 1995. Both management areas were expanded in 1995 (northward in 2JN and eastward in 2JS) to provide opportunity to maintain catch rates by accessing new grounds.

Div. 3K: Landings increased to 12,245 t in 1995 from 11,039 in 1994 (Table 1). The overall catch rate has declined from 14.5 kg/trap haul in 1993 to 11.5 kg/trap haul in 1995. This is mainly attributable to declines in area 4 and inshore areas 3A and 3D. Catch rates in most offshore areas remained high.

Div. 3LNO: Landings, 90% from Div. 3L, totalled 13,790 t in 1995, up from 12,237 t in 1994 (Table 1). The overall catch rate has been increasing steadily from 7.8 kg/trap haul in 1990 to 17.0 kg/trap haul in 1995. Catch rates remained high in all management areas in 1995 and were particularly high in newly-exploited areas near the 200 n mi limit.

Div. 3Ps: Landings increased to 1,853 t in 1995, up from 1,590 t in 1994 (Table 1). The overall catch rate dropped from 15.2 to 10.0 kg/trap haul indicating an approximate doubling of effort. Catch rates remained high in areas 10 (at more than 3 times the 1990 and 1991 values) and in 10X but declined in area 11.

Div. 4R: Development of the west coast crab fishery continued in 1995 with 47 new, temporary permits issued for six coastal areas (to 8 mi off). This component of the fishery landed 200 t in 1995. The remaining permit holders landed 720 t in 1995 at a mean catch rate of 5.9 kg/trap haul (Table 1). This was up from 655 t at 5.5 kg/trap haul in 1994.

Table 1. Landings (t) and commercial catch rate (kg/trap haul) by NAFO Division, 1990-95.

Div.	1990	1991	1992	1993	1994	1995
2J	645	989	1,529	2,275	2,978	3,178
	(12.8)	(14.6)	(12.5)	(12.9)	(9.6)	(7.9)
3K	4,253	7,675	7,295	9,760	11,039	12,245
	(10.7)	(12.4)	(12.0)	(14.5)	(13.4)	(11.5)
3LNO	5,211	6,394	6,652	8,979	12,237	13,790
	(7.8)	(8.6)	(12.7)	(14.3)	(15.7)	(17.0)
3Ps	596	176	121	704	1,590	1,853
	(4.8)	(4.5)	(9.4)	(10.6)	(15.2)	(10.0)
4R	-	-	-	-	655	920
					(5.5)	(5.9)

Research Surveys

Research surveys using commercial and small-meshed traps have been carried out in three crab management areas in Div. 3L since the early 1980's. Similar surveys were carried out in Div. 3K (White Bay) in 1994 and 1995. A model was developed for each Div. 3L survey area which uses the survey catch rate of legal-sized (including soft) crabs to provide an indication of commercial catch rate in the following year. Yearly trends in survey catch rate of sub-legal sized males from small-meshed traps are also monitored as an index of future recruitment. Crabs of 76-94 mm CW (Prerecruit 1 group) which have small claws will continue to molt and could begin recruiting to the fishery, as hard-shelled crabs, in two years. Smaller crabs of 60-75 mm CW (Prerecruit 2 group) which have small claws could begin recruiting in three years. Data on claw type were available only since 1988.

In 1995, with the introduction of a new survey trawl, data on snow crab were available for the first time from the annual fall bottom trawl survey. This stratified random survey sampled an extensive area of snow crab distribution throughout Div. 2J3KLNO. Data on catch rate of males by size and molt status (large-clawed versus small-clawed) were summarized by division.

Resource Status

Commercial catch rate in Div. 3L remained high in 1995, as had been predicted by the abundance of legal-sized crabs in the 1994 trap surveys (Fig. 3). Abundance of legal-sized crabs remained high in the 1995 surveys, indicating that commercial catch rates should continue to be high in 1996.

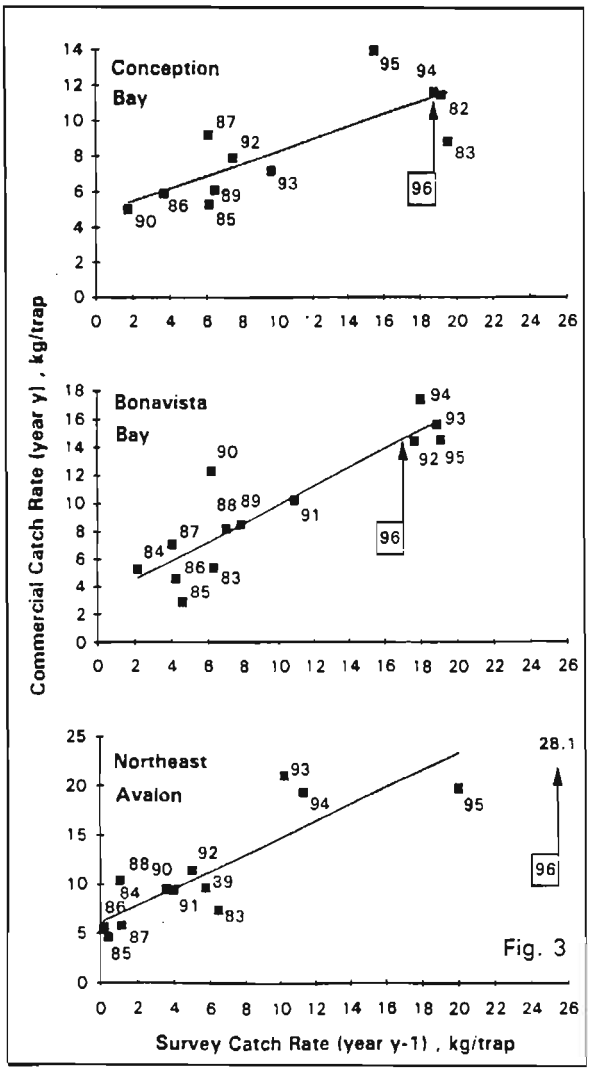


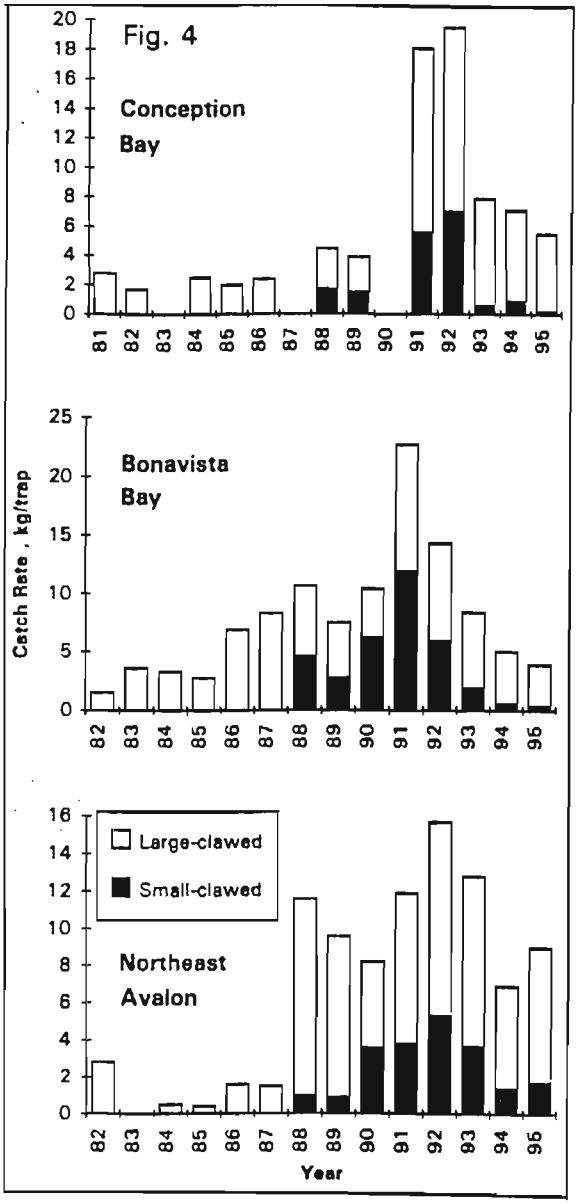
Fig. 3

Survey catch rates of Prerecruit 1 crabs, especially those with small claws, began declining in 1992 or 1993 (Fig. 4). They generally remained low in 1995, as did catch rates of smaller Prerecruit 2 crabs. This suggests that recruitment is declining in Div. 3L and this trend is expected to continue for at least the next two years. Trap survey data also indicate that there has been an increase in the proportion of old-shelled crabs in Div. 3L since 1992 (Table 2). This likely reflects declining recruitment and low exploitation rate in an ageing standing stock. It is believed that crab carapaces become fouled or 'mossy' after about three years from their final molt such that they are undesirable for the crab section market. Such old-shelled crabs probably live for another 2-3 years.

Table 2. Percentage old-shelled in large-meshed trap catches of legal-sized crabs.

	Survey area		
Year	Conception Bay	Bonavista Bay	Northeast Avalon
1990	-	3.7	8.7
1991	3.1	4.2	2.2
1992	1.5	4.2	1.6
1993	1.0	7.1	1.9
1994	2.6	11.9	2.1
1995	15.3	14.3	6.5

The trap survey catch rates for White Bay (Div. 3K) were generally similar for 1994 and 1995. However, commercial catch rates have declined over the past two years in Div. 3K and 2J suggesting that a decline in commercial biomass may have begun in the most northern areas. For other divisions there are no data from trap surveys. The status of crab in Div. 3Ps, where the 1995 catch rate declined to approximately the 1993 level, is unclear because only commercial data are available. Interpretation of commercial catch rate data may be confounded by uncertainties due to spatial and seasonal variation in fishing practices.



Trends in trap catch rates of small-clawed prerecruit crabs must be interpreted with caution, because traps may not efficiently sample small-clawed crabs. However data from the 1995 fall bottom trawl survey also suggest that the abundance of prerecruit crabs is low relative to that of commercial crabs in Div. 3L. Trawl catch rates were lower in Div. 2J and 3K than in Div. 3LNO. They were particularly high for prerecruits in virtually unexploited Div. 3N.

The fishery has apparently been supported by widespread strong recruitment during the early 1990's. The current recruitment decline is similar to a trend which is evident in other Canadian Atlantic snow crab fisheries. Declining recruitment has already negatively impacted the fishery in Gulf of St. Lawrence areas, where trawl survey data indicate poor prospects for recruitment over the next several years.

Outlook

Trap surveys in Div. 3L indicate that the fishery should continue to perform well in 1996. However, recruitment appears to be declining and this should eventually be reflected in declining commercial catch rates. Div. 2J and 3K already show signs of declining catch rate. As recruitment declines the trend for increasing incidence of old-shelled crabs can be expected to continue if exploitation levels remain low.

For More Information

Research Documents:
Dawe, E.G., D.M. Taylor, P.J. Veitch, H.J. Drew, P.C. Beck, and P.G. O'Keefe. 1996. The status of Newfoundland and Labrador snow crab. DFO Atl. Res. Doc. 96/ .

Taylor, D.M., and P.G. O'Keefe. 1996. Summary of performance of the 1995 Newfoundland and Labrador snow crab fishery. DFO Atl. Res. Doc. 96/ .

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STOCK STATUS REPORT
GRAND BANKS OF NEWFOUNDLAND (NAFO DIV. 3LN) ICELAND SCALLOPS

Background

Iceland scallops are widely distributed within the subarctic. In Newfoundland, populations are normally found in waters from 55 m-200 m, usually on hard bottom with variable substrate composition consisting largely of sand, gravel, shell fragments, and stones. Being a filter feeder, the species is most abundant in areas with strong currents as in the Strait of Belle Isle in the northeastern Gulf of St. Lawrence. Other areas where Iceland scallops are found in commercial quantities include St. Pierre Bank (Div. 3Ps) and Grand Bank. Elsewhere, they are harvested in Greenland, Iceland, Norway and Russia.

Unlike many species of scallops, the Iceland scallop is dioecious (i.e. each animal is either male or female). They become sexually mature at three to six years of age. Spawning in Newfoundland begins around April-May and is thought to be triggered by short-term variations in temperature. The species is highly fecund producing millions of eggs which are externally fertilized. Larvae are planktonic for up to 10 weeks before settling out on substrates, including shell debris and filamentous materials. Settlement is gregarious resulting in densities sometimes approaching 100 animals per square meter.

Growth rates and meat yield vary from one area to another. It takes approximately 7-8 years to reach commercial size of about 65 mm (or 2.5") in shell height. The animals frequently live in excess of 25 years, but seldom exceed sizes greater than 100 mm (or 4").

The directed fishery for Iceland scallops in Newfoundland began in the Strait of Belle Isle in 1969, but has now expanded into St. Pierre Bank (1989) and the Grand Banks (1993). Each area is now regulated by catch levels and by seasons. Currently TACs on the Grand Banks apply only to specific subareas within 3L and 3N.

The Fishery

The directed fishery for Iceland scallops on the Grand Banks of Newfoundland is quite recent. After several years of exploratory fishing and commercial trials, fishing activity began in earnest in 1993 with a total of 10 vessels participating. The majority of removals in the first year had come from NAFO Div. 3L, the remainder (3 t) being from 3N. A variety of gear types are used including the Labrador rake, the New Bedford rake and traditional Digby buckets. Catch rates are highly variable with meat count typically in the 40-80/lb range. Nominal catch has increased in each of the two years following. The high economic return resulted in a six-fold increase in 1994 in the number of vessels (to 57). Total number of active vessels declined in 1995 to 48.

Nominal catch (t, round) and effort of Iceland scallops from NAFO Div. 3LNO. All figures are based on the species-specific conversion factor of 9.2.

		NAFO Division			
Year	No. vessels	3L	3N	3O	3LNO
1992	1	17	2	-	19
1993	10	456	3	-	459
1994	57	91	4,478	2	4,571
1995	48	174	6,126	3	6,303
Totals		738	10,609	5	11,352

Of this 33 (or 75%) were in the 55-65 ft range. In just three years the accumulated catch from the Grand Banks of Newfoundland has surpassed 11,000 t round. Over half (56%) of this was taken in 1995. The majority (93%) of removals came from NAFO Div. 3N, particularly from the highly productive grounds near the Lilly Canyon and Carson Canyon. Scallop meats here tend to be larger (low meat counts) than elsewhere on the banks and consequently attracts most of the effort. The inordinately high effort into these areas specifically to obtain low count

catches has quickly resulted in an increase in the proportions in the catch of small meats to larger ones. Also, overall mean catch rates have decreased by 20% in 1995. Extreme caution should be exercised in harvesting this limited concentration along the canyons.

Catch rates (lb meats/tow) in 1994 and 1995:

Year	Range	Mean
1994	22-35	27
1995	17-43	21

Changes in percent composition of meat counts in scallop catches from 3N (Lilly Canyon/Carson Canyon), 1994-95.

Meat count (nos./lb.)	April 1994	October 1994	August 1995
1-9	0	0.1	0
10-19	2.4	1.5	0
20-29	34.8	29.2	0.4
30-39	40.2	36.6	5.5
40-49	17.5	22.0	21.5
50-59	4.0	8.0	25.2
60-69	0.9	2.2	23.3
70-79	0.3	0.3	12.7
80+	0.1	0.1	11.4
N	2,209	1,071	1,629

Subareas within 3L and 3N were placed under a TAC regime in 1995: 1000 t shellstock for 3L (northern area) and 3000 t shellstock for 3N (Lilly and Carson Canyons).

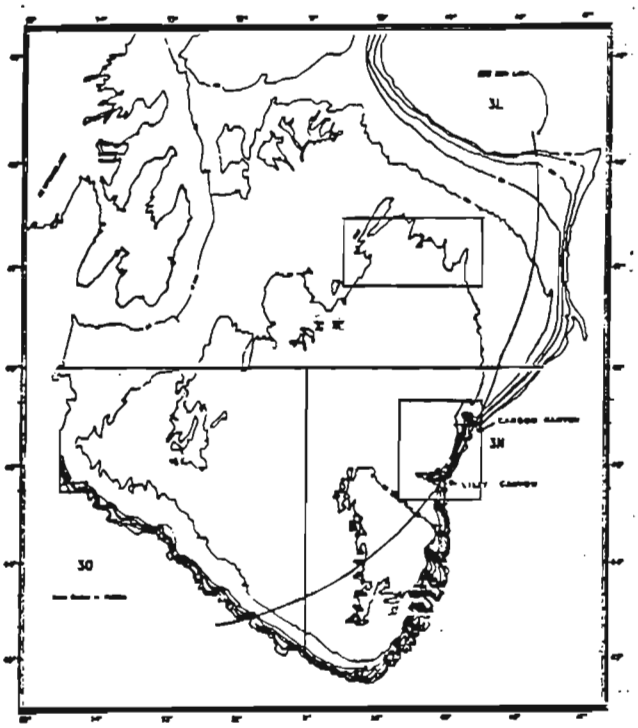

Fig. 1. Two areas (boxes), one each in NAFO Div. 3L and 3N under TACs in 1995.

Nominal catch from the Grand Banks in 1995, including the two areas each managed by TAC is estimated at 6,303 t round. Much of the interest remained around the Canyons which together produced nearly 50% of total removals. Once the TAC had been taken the fleet moved on to aggregations just outside of the "box" in 3N. Trending northeastwards, these aggregations appear to be contiguous to those around the Canyons.

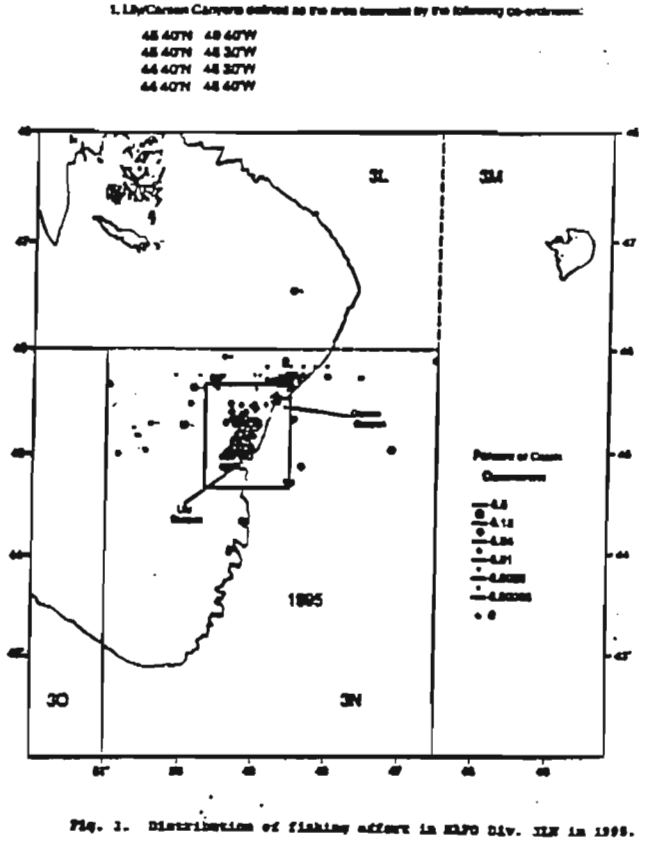

Fig. 1. Distribution of fishing effort in NAFO Div. 3LN in 1995.

In sum, this "new" non-TAC area produced almost as much as the Canyons (2,913 t versus 3,023 t round or 48% of total). Only sporadic effort (77 days total) was expended outside of these two areas resulting in a further removal of 188 t (or 3% of the nominal catch in 1995).

Research Surveys

While several exploratory surveys, both private and public, have been conducted over the Grand Banks, quantitative information on resource abundance is scant. The sporadicity of good catches has suggested the occurrence of massive beds to be unlikely. Scientific surveys were conducted in 1989 (3N) and 1994 (3LN). An acoustic seabed classification system using ROXANN was deployed in 1996 to identify areas in NAFO Div. 3N most likely to contain scallop aggregations. The survey was run between 45°40'N and 46°00'N. This will greatly assist us with a cost-effective survey in the near future, possibly as early as next year.

The most recent (1994) survey estimated scallop biomass around the Canyons (NAFO Div. 3N) at between 19,600 and 38,000 t (mean = 28,800 t) round. A 3,000 t TAC had been recommended (10% exploitation rate). Similarly, total biomass in an area surveyed in 3L pointed to a biomass between 4,000 and 15,000 t(mean = 9,500 t) round. Again, using a 10% exploitation rate a TAC of 1,000 t shellstock had been recommended for 3L.

In 1995, a resource survey was conducted into the aggregation extending northeastwards from the canyons, including portions of NAFO Div. 3LN that straddle the 200 mi Canadian Economic Zone.

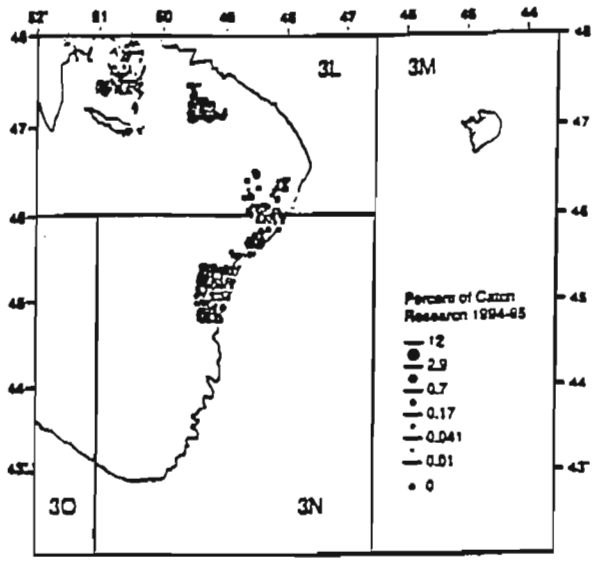

Fig. 3. Areas surveyed in 1989 (3N), 1994 (3L and 3N (canyons)), and 1995 (3LN, nose of the Grand Banks).

Using ROXANN approximately 2,144 n mi^2 of seabed was first classified to determine extent of benthic assemblages likely to contain scallops. About 1,152 out of 2,144 mi^2 (or 52%) were in 3L and the remaining 27 (or 48%) were in 3N. Scallops from 3N are slightly larger, provide higher yield than scallops from 3L (12.8% versus 11.3% respectively) and hence lower counts (40 versus 55/lb).

Two aggregations were identified where scallop densities are significantly higher than the area surrounding (97 and 158 lb versus 20 lb/one mile tow

with a 12 ft New Bedford rake). Patch estimates each covering approximately 50 and 138 n mi^2 were developed for the aggregations. Using a 20% gear efficiency as in previous years we estimate fishable biomass at 15,000-45,000 ($\bar{x}$ = 30,000 t) round. At 10% exploitation this would suggest a catch in 1996 of approximately 3,000 t round for the new area.

Outlook

We now have estimates of abundance for three aggregations of Iceland scallops on the Grand Banks of Newfoundland. It should be emphasized that the fishery is still taking the accumulated biomass from several years recruitment. This is reflected in the CPUE trends which appear to indicate that the fleet moves around to locate and fish 'hot' spots but move on once the catch drops below some threshold level. Based on the 1994 survey, it is proposed that the 1995 TAC of 3,000 t shellstock for the Canyons be continued into 1996. It should be noted, however, that as of May 18, 1996 some 2,400 t have already been taken under an interim quota management. This leaves a residual TAC of only 600 t for the Canyons.

In the absence of any significant removals from 3L, the TAC of 1,000 t round for this area can be continued. In addition to the above a further catch of 3,000 t round is proposed for the new area bounded by 45°30'N, 46°30'N and 47°30'W, 49°40'W.

There are other areas where scallop densities may be sufficiently high to warrant commercial activity. However, we have no information on the size and distribution of these aggregations.

For More Information

Research Document:
Naidu, K.S., F.M. Cahill, E.M. Seward, and P. J. Veitch. 1996. The burgeoning fishery for Iceland scallops on the Grand Banks of Newfoundland. DFO Atl. Res. Doc. 96/76.

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STOCK STATUS REPORT STRAIT OF BELLE ISLE (NAFO DIV. 4R) ICELAND SCALLOPS

Background

Iceland scallops are widely distributed within the subarctic. In Newfoundland, populations are normally found in waters from 55 m-200 m, usually on hard bottom with variable substrate composition consisting largely of sand, gravel, shell fragments, and stones. Being a filter feeder, the species is most abundant in areas with strong currents as in the Strait of Belle Isle in the northeastern Gulf of St. Lawrence. Other areas where Iceland scallops are found in commercial quantities include St. Pierre Bank (Div. 3Ps) and Grand Bank. Elsewhere, they are harvested in Greenland, Iceland, Norway and Russia.

Unlike many species of scallops, the Iceland scallop is dioecious (i.e. each animal is either male or female). They become sexually mature at three to six years of age. Spawning in Newfoundland begins around May-June and is thought to be triggered by short-term variations in temperature. The species is highly fecund producing millions of eggs which are externally fertilized. Larvae are planktonic for up to 10 weeks before settling out on substrates, including shell debris and filamentous materials. Settlement is gregarious resulting in densities sometimes approaching 100 animals per square meter.

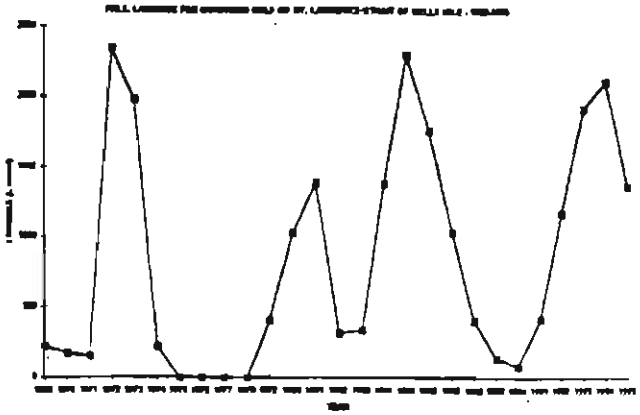
Growth rates and meat yield vary from one area to another. It takes approximately 7-8 years to reach commercial size of about 65 mm (or 2.5") in shell height. The animals frequently live in excess of 25 years, but seldom exceed sizes greater than 100 mm (or 4").

The directed fishery for Iceland scallops in Newfoundland began in the Strait of Belle Isle in 1969. Until recently, other than vessel size restrictions, the fishery remained largely unregulated. Quotas were first put in place in 1993 and have ranged between 1500 and 2000 t.

In addition to the Strait of Belle Isle, directed fisheries for the Iceland scallop commenced on St. Pierre Bank and the eastern Grand Banks of Newfoundland in 1989 and 1993 respectively. Each stock is now regulated by catch levels and by seasons.

The Fishery

From its inception the amount of effort in the day-fishery in the Strait of Belle Isle was based on price and availability of scallops relative to other species. Four strong peaks in landings are evident: 1972-73, 1980-81, 1984-86, and 1992 to present. In the past, each peak was followed by several consecutive years of poor catches. The sharp increase in landings in 1972 and 1973 was concomitant with a changeover to 2.5" rings from 3.0" rings in scallop rakes. The widespread use of the more efficient "Labrador rake" beginning in the mid-1980's also contributed to the higher landings thereafter as did record prices and exploitation of new grounds.



Beginning in 1991, the bulk of the fishery returned south of 51°25'N to beds once considered most prolific. Scallop aggregations here had apparently recovered following an extended fallow period.

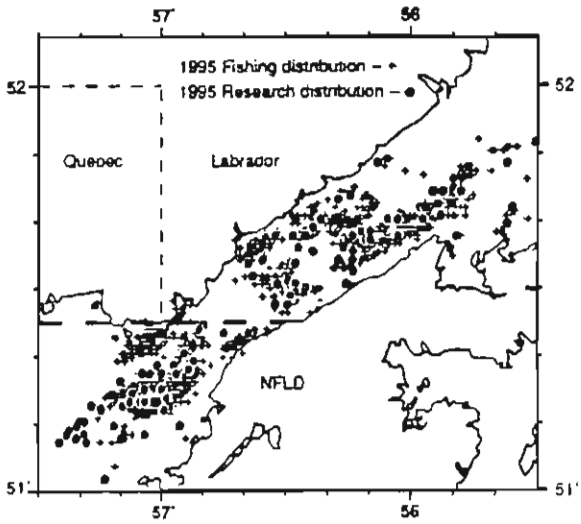
Nominal fishing effort increased dramatically between 1990 (11 vessels) and 1994 (80 vessels) but declined in 1995 (40 vessels). Overall catch rates in 1994 dropped by 30% from 1993. As well, within season catch rates in 1994 declined from 89 lb/tow to 74 lb/tow.

In 1995, all measures of CPUEs examined continued the downward trend detected in 1994. Overall, catch/tow in comparable zones declined to 57 lb/tow from 70 lb/tow in 1994, a drop of 19%. Also, contributions to total catch south of 51°25'N continued to decline in 1995 (from 90% in 1993 to only 46% in 1995). Catch rates in this area experienced a further decline of 32% in 1995 from the 30% reduction already noted between 1993 and 1994. Fishing effort has become increasingly dispersed. Removals from the exploratory area to the north of a line drawn from Cape Bauld to Chateau Point continue to be low. The pattern of decline shown by the CPUE data has been corroborated by a number of stakeholders directly involved in the fishery.

Research Surveys

Research surveys were conducted annually between 1973-76 and 1980-82 but became less frequent thereafter. A survey in 1995, the first in eight years, combined acoustics and dredge haul sampling. Approximately 70% of the survey area (599 out of 847 mi^2) was found to be unsuitable for scallops. Catch rates were low throughout. The stock is presently composed of local concentrations of old individuals. Scarcity of juveniles throughout the area surveyed suggested that prospects for recruitment in the short-to-medium term are poor. Biomass is estimated at 10,000-14,000 t ($\bar{x}$ = 12,000 round). A 10% exploitation rate is usually considered appropriate for this slow growing species. This would suggest a catch in 1996 in the range of 1000-1400 t.

Survey coverage (closed circles) relative to distribution of fishing effort in 1995.



Ecological Factors

Anecdotal reports suggest that starfish numbers (a major predator of scallops) have increased dramatically in the Strait of Belle Isle. The high proportion of cluckers to live scallops observed in 1995supports this observation. There is also a high gear induced non-yield mortality in this fishery.

Nearly all (90%) of the scallops were shucked at sea and shells thrown overboard. The discarded shells constitute a preferred settlement material for scallop larvae. This fishery operates over nursery areas and recently settled seed are particularly vulnerable to intense fishing activity.

Outlook

The residual biomass is made up of old scallops. Recruitment appears to be low throughout. Consequently, there is little potential for growth in standing stock. Even at a 10% exploitation rate, declines in stock biomass and catch rates are inevitable. Rebuilding of the stock may be hampered by the fact that the fishery continues to operate over nursery grounds. This is compounded by the limited area available for expansion.

Monthly CPUE estimates for the Iceland scallop fishery in the northern Gulf of St. Lawrence 1994 and 1995. (1994 data re-examined to make area-specific comparisons).

Year	Month	Removals (t, round)	CPUE lb/tow
1994	May	1.4	43
	June	755.3	76
	July	927.1	73
	August	229.1	58
	September	191.4	59
	October	1.1	58
1994 totals		2105.4	70
1995	June	237.5	57
	July	462	57
	August	434.8	60
	September	201.6	53
	October	16.1	46
1995 totals		1352	57
% reduction 1994-95		36	19

For More Information

Research Document:
Naidu, K.S., F.M. Cahill, and E.M. Seward. 1996. Abundance of Iceland scallops in NAFO Div. 4R (Strait of Belle Isle) declines further in 1995. DFO Atl. Res. Doc. 96/xx.

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Background

The hooded seal is the second most abundant, and largest, seal species in the Northwest Atlantic. Adult males average 2.6 m in length and weigh about 300 kg; females are significantly smaller averaging 2.2 m and 160 kg respectively.

Like harp seals, hoods give birth (whelp) on pack ice. In the Northeast Atlantic, whelping occurs near Jan Mayen off the east coast of Greenland, while in the northwest, it occurs off the coast of southern Labrador or northeastern Newfoundland (the 'Front'), in Davis Strait, and in the Gulf of St. Lawrence (the 'Gulf'). It is not known how much interbreeding there is among hooded seals whelping in different areas of the Northwest Atlantic, but seals from all three areas are known to mix during the non-breeding period.

Hooded seals are seasonal migrants, spending most of the year in offshore waters. In the Northwest Atlantic, they summer off south and west Greenland or in the Canadian Arctic, and migrate to the whelping areas during the late fall or early winter. A single pup, called a blueback, is born during late March. After the pup is weaned, the female mates and then disperses to feed. Recent data obtained using satellite transmitters show that hooded seals that whelp at the Front move off the Continental Shelf towards either the Flemish Cap or Rekjanes Ridge, southwest of Iceland. Eventually they migrate to Denmark Strait near southeast Greenland to moult in late June or July. Seals that whelp in the Gulf, move to the north slope of the Laurentian Channel where they feed before migrating out the Cabot Strait and along the shelf-edge of the Grand Banks enroute to Denmark Strait.

The nursing period of hooded seals is the shortest known, averaging only 4 days, during which the pups grow extremely fast, gaining 7 kg/day. The blueback undergoes its first moult at approximately 16 months, although the 'blueback' pelage is retained until it is 2 or 3 years of age.

Northwest Atlantic Hooded Seals

photo: B. Bergfledt

The Fishery

Commercial sealing for hooded seals at the Front was reported as early as 1874, but records of catches are lacking because no distinction was made between harp and hooded seals for many years. Following a shift to hunting for fur in the 1940s, the hooded seal pup, or blueback, became the most valuable of all pelts and hunting effort increased accordingly. Before implementation of quotas in 1974, annual catches varied greatly, ranging from less than 1,000 to just over 25,000 seals. From 1974-82 the harvest was fairly constant, averaging 12,800 per year, and made up primarily of pups taken during the large vessel hunt. Following the demise of this hunt, commercial catches varied from a low of 33 in 1986 to a high of 6,425 in 1991, averaging 1,048 for the period 1983-92. In recent years annual catches have continued to vary greatly with over 25,000 reported harvested in 1996. The highly variable number of hooded seals taken in any one year is likely due to the accessibility of the seals to land-based hunters.

Table I: TAC and commercial catches of hooded seals (,000s) in Atlantic Canada 1974-1996.

	1974 - 82	1983-92	1993	1994	1995	1996
TAC	15.0	2.3 - 15.0[a]	8.0	8.0	8.0	8.0
Catch	12.80[b]	1.05[b]	0.02	0.15	0.86	25.70[c]

[a] varied among years; see text for explaination
[b] annual average
[c] Preliminary figures

Prior to 1974 there was no TAC set for hooded seals, although there were restrictions on the hunting season. In 1974, a TAC of 15,000 was implemented for Canadian waters. During the late 1970s a number of regulatory changes were enacted to limit the percentage of adult females in the harvest. The TAC was reduced to 12,000 in 1983 and then further reduced to 2,340 in 1984. Hunting of bluebacks for commercial purposes and the use of vessels over 18 m was prohibited in 1987. In 1991 the TAC was increased to 15,000 and then set at 8,000 in 1992 where it presently remains. Hunting in the Gulf of St. Lawrence has been prohibited since 1964 and there are no catches of hooded seals in the Davis Strait whelping concentrations.

Hooded seals from all three whelping areas in the Northwest Atlantic are hunted in Greenland. From 1976 to 1985, catches were estimated to be about 6,000 seals per year. Unfortunately, the level of harvest from 1986 to 1992 is unknown, since information on catches is insufficient or lacking. Greenland has recently established a new harvest management program and, although the initial estimates obtained from this new program must be verified, it is estimated that approximately 7,000 seals were taken in both 1993 and 1994. These catch levels are similar to those observed in the late 1970s.

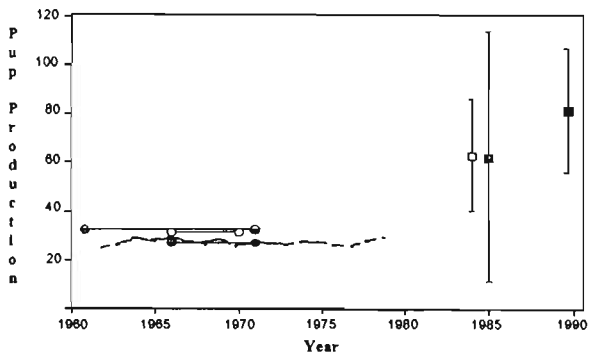
Historically, Northwest Atlantic hooded seals were also hunted at the moulting concentrations in the Denmark Strait, but this ended in 1967. An unknown number of hooded seals are incidentally caught in deepwater groundfish trawls in all areas of their range.

Resource Status

The total number of hooded seals in the Northwest Atlantic cannot be assessed directly because seals are distributed widely across the north Atlantic for most of the year. Even though adult seals congregate on the ice to whelp and to moult, the entire population is never visible at the surface at any one time. However, since all pups do remain on the ice for a short period of time while being nursed, hooded seal populations can be assessed by estimating the number of pups born.

In the Northwest Atlantic, the largest number of pups are born at the Front. A series of pup production estimates are available for this stock, but different methods were used and they are not all directly comparable. Pup production from 1966-1977 was estimated to be in the order of 25,000-32,000, based on either a survival index analysis or a sequential population analysis. The results of aerial surveys conducted in 1984 indicated that pup production was approximately 62,000 (95% C.I. 43,700-89,400). Although this estimate was higher than previous ones, little could be said about trends in pup production because of the different techniques used. Aerial surveys carried out in 1990 using methods similar to those used in 1984 produced an estimate of 83,000 (SE=12,600). Comparing the results of the 1984 and 1990 aerial surveys suggest that pup production has increased slowly at 5% per annum during the late 1980s. However, because of the wide confidence intervals the two estimates are not significantly different.

Fig. 1. Estimates of hooded seal pup production (thousands) at the Front 1966 - 1990 from cohort analysis (dashed line), survival index (circles and solid line) and aerial surveys (boxes).



The second most numerous stock of hooded seals in the Northwest Atlantic whelp in Davis Strait. The only estimate of pup production in this area, 18,600 (95% C.I. 14,000-23,000), was obtained from aerial surveys conducted in 1984.

The small number of hooded seal pups born in the Gulf of St. Lawrence have been surveyed several times in recent years. In 1990 pup production was estimated to be about 1,600 (SE=460), while in 1991 it was 2,000 (SE=190).

The area was surveyed again in 1994, resulting in an estimate of almost 4,000 pups (SE=970). However, because of the short nursing period, survey estimates must be corrected for pups which were not present on the ice at the time. In 1994, the proportion of pups present on the ice during this survey was small, a large correction factor was used and therefore, the estimate should be viewed with caution.

The total pup production for the Northwest Atlantic stock of hooded seals is unknown because the three whelping areas have not been surveyed in the same year and estimates obtained in different years cannot be combined without information on the degree of mixing. In the absence of such information, the ICES/NAFO Working Group on Harp and Hooded Seals agreed that a minimum pup production estimate of slightly over 84,000 (SE=12,600) was obtained by combining the 1990 estimates from the Front and Gulf. They noted that this is conservative since it does not include possible whelping in Davis Strait in 1990 or for changes in the total pup production since these surveys.

There is no recent population model available to estimate total population from the numbers of pups. However, based upon models developed for harp and grey seals which have similar biological characteristics, a pup production of about 84,000 would represent a total population in the order of 450,000 hooded seals.

Replacement Yield

The replacement yield is the number of seals that can be harvested in one year without changing the total population. In order to estimate a replacement yield, information on catch levels, age specific pregnancy rates, and mortality rates of adults and pups are needed. Although it has been difficult to obtain many of these data for hooded seals, the NAFO Scientific Council reviewed the available information on hooded seal population dynamics in June 1995 and estimated 1996 replacement yields in the order of 24,000 - 29,000 seals for the Northwest Atlantic. These estimates vary with the proportion of pups in the harvest (0-60%) and apply to catches in Canada and Greenland. It is important to note that these estimates are based upon a number of assumptions concerning the reproductive rates of hooded seals and the level of natural mortality. Therefore, estimates of replacement yield are sensitive to changes in these assumptions as well as the age of the catches.

Fisheries Interactions

Hooded seals spend considerable time in areas that are exploited by commercial fisheries in the Northwest Atlantic. Their diet has been determined by reconstructing the stomach contents of seals collected in the waters off Newfoundland using hard part such as fish otoliths. A total of 14 fish and 8 invertebrate prey groups were identified in the stomachs of hooded seals sampled in nearshore areas. Greenland halibut (*Reinhardtius hippoglossoides*) was the most important prey species making up 42% of the total wet weight of prey recovered. Other important species include redfish (*Sebastes spp*, 20.6%), Arctic cod (*Boreogadus saida*, 15.5%), Atlantic herring (*Clupea harengus*, 14.0%), squid (*Gonadus spp.*, 7.2%), and Atlantic cod (*Gadus morhua*, 1.2%). In offshore areas hooded seals consume a similar suite of prey species although the proportions of redfish (3.3%) and arctic cod (less than 1 %) taken were notably lower while the proportion of Atlantic cod was higher (10.1%). In addition to geographical differences, the diet of hooded seals varied on a seasonal basis, especially with respect to the proportion of redfish, herring and arctic cod present. Most of the fish consumed by hooded seals were 15 - 35 cm. Unfortunately, there is no information on the diet of hooded seals in the Gulf of St. Lawrence. Efforts to estimate the consumption of fish by hooded seals in the Northwest Atlantic are currently underway.

For More Information

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Myers, R.A. and G.B. Stenson. 1995. Replacement yield of hooded seals in the Northwest Atlantic. NAFO SCR Doc. 95/40, Serial No. N2549.

Ross, S.-A. 1992. Food and feeding of the hooded seal (*Cystophora cristata*) in Newfoundland. M. Sc. Thesis. Memorial University.

Stenson, G.B., R.A. Myers, I-H. Ni and W.G. Warren. 1995. Pup production of hooded seals (*Cystophora cristata*) in the Northwest Atlantic. NAFO SCR Doc. 95/16, Serial No. N2523.

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STOCK STATUS REPORT

CAPELIN IN SUBAREA 2 + DIV. 3KL

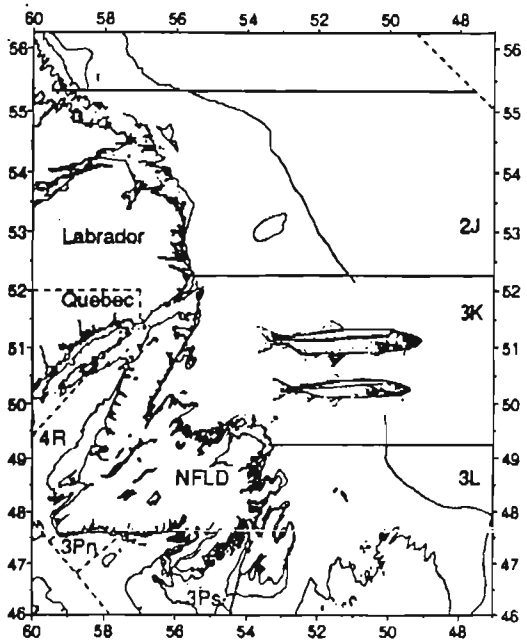
Background

Capelin is a small pelagic schooling species with major populations occurring in the Northwest Atlantic, in waters around Iceland, in the Barents Sea and in the northern Pacific. For several years, capelin in SA2 + Div. 3K and Div. 3L were treated as two stocks but, as a result of accumulated evidence, scientists recommended in 1992 that capelin in these areas be considered one stock complex.

Adult fish range in size from about 12 to 23 cm with males being larger than females. The spawning populations are comprised of mainly three and four year old fish. This, coupled with low spawning survival and variable recruitment, offers the potential for frequent and dramatic changes in mature biomass.

Juvenile capelin of the SA2 + Div. 3KL stock can be found both in major bays and in offshore waters although the northern Grand Bank and Northeast Newfoundland Shelf are thought to be major nursery areas. At maturity, schools of adults migrate inshore to spawn on Newfoundland beaches during June and July. After the eggs have hatched, the larvae exit the beach gravel and most are carried out of the bays rapidly by surface currents.

Capelin are preyed upon by many predators including seals, whales, cod, Greenland halibut, salmon and seabirds. They are considered to be a key element in the food chain. This prominent position in the ecosystem has resulted in a conservative approach to their management. In the late 1970's, scientists recommended that no more than 10% of the projected mature biomass be removed annually in a commercial fishery.



The Fishery

Historically, a small domestic fishery (annual harvest estimated at about 25,000 t) for capelin on the Newfoundland spawning beaches existed to provide food, bait and fertilizer. A directed foreign offshore fishery began in the early 1970's and was closed in Div. 3L and in Div. 2J3K beginning in 1979 and 1992, respectively. During the late 1970's, an inshore fishery for roe capelin began. Throughout the 1980's, the inshore fishery usually started by mid-June in the south and finished about mid-July in the north.

The main gear types in the inshore fishery are traps, purse seines and, to a lesser extent, beach seines. The primary market is for frozen roe-bearing female capelin in Japan. This market is limited and the demand for quality is high. Failure to meet quality standards results in discarding. Most males are discarded.

Inshore catches during the 1980's were usually about the same as the TAC, largely because the TAC was based on expected market demand. Catches in the 1990's have been more variable when compared to the TAC. This was especially evident in Div. 3L in 1992 and throughout the area in 1994 when catches were well below the TAC's. A summary of catches and TACs (tons x 10^{-3}) since 1989 is given below.

	1989	1990	1991	1992	1993	1994	1995
SA2 + Div. 3K							
Offshore							
Advised TAC	b	107	57	-	-	-	-
TAC	20	71	57	0	0	0	0
Nominal catch	22	57	0.5	0	0	0	0
Inshore							
Advised TAC	b	107	f	d	d	a	-
TAC	24.1	29	29	17	11.4	11.5	11.5
Nominal catch	28	33	20	18	13c	<.1c	<.1c
Div. 3L							
Advised TAC	335	350	e	e	d	a	-
TAC	46	56	56	19.3	21	21	22
Nominal catch	52	48	22	3	23c	1c	1c
SA2 + Div. 3KL							
Total nominal catch	102	138	42.5	21	36	1	1

a data not adequate to advise a TAC
b total inshore and offshore catches could be 200,000-250,000 t without exceeding 10% target exploitation rate
c provisional
d lowest possible level
e NAFO concluded that a catch of 50,000 t as in recent years would not exceed a 10% exploitation rate
f catch should not exceed that of previous year

In 1995, the fishery did not open. In 1994 and 1995, the average size of female capelin was too small to meet the management plan size criterion of 50 count/kg.

Since 1991, the fishery has been delayed by up to four weeks because of the late arrival of capelin, probably linked with unusually cold water temperatures. In 1994 and 1995, capelin were again later than normal arriving inshore although not as late as in 1993.

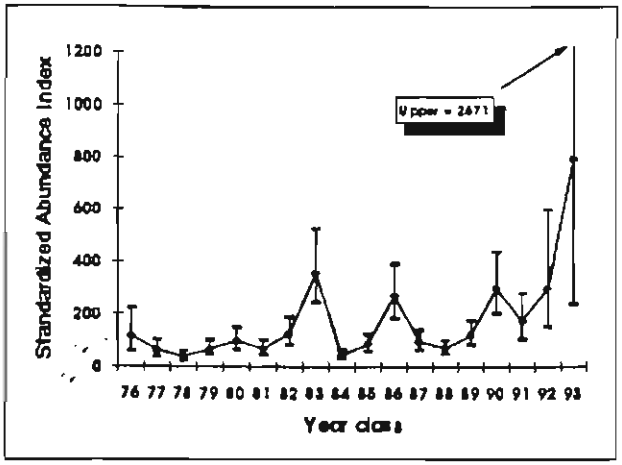
Resource Status

In the evaluation of resource status, several indicators were combined in a mathematical model which averaged the information from the different indicators and provided relative estimates of yearclass strength. The indicators used in the model were:

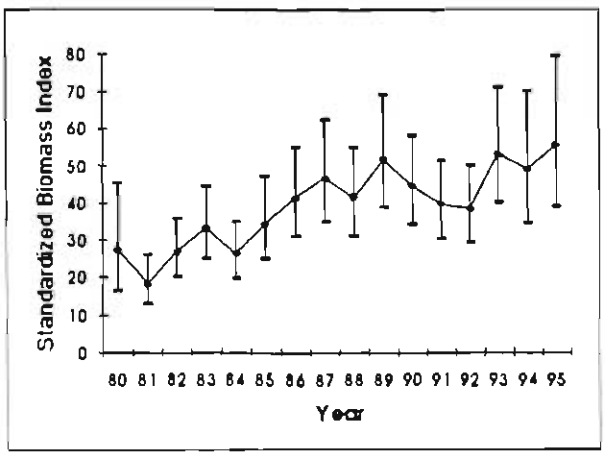
1) aerial survey index 1982-95
2) purse seine catch rate index 1981-93
3) trap catch rate index 1981-93
4) groundfish 3L fall bycatch 1985-94
5) groundfish 2J3K fall bycatch 1985-94
6) Russian 2J3K fall commercial catch rate index 1972-91
7) egg deposition index 1990-95

Only the aerial survey and the egg deposition indices provided information on the 1993 yearclass and the 1995 mature biomass. The 1995 aerial survey index was the third highest in the series and the egg deposition index was the second highest.

Results from the model indicate that the 1983 and 1986 yearclasses were strong and that those of the early 1990's (i.e. 1990 to 1993, inclusive) also were very abundant. The 1993 yearclass appears exceptionally strong but there is uncertainty (large 95% confidence intervals) about the estimate.



Results from other surveys at early life stages also indicate that the 1990, 1992, 1993 and 1994 yearclasses are abundant. Large yearclasses in the 1990's would imply that biomass should have been increasing. However, the decline in mean individual fish size during the same time period tends to counterbalance the increase in numbers. The annual biomass index was estimated to be at an historically high level during the 1993-95 period but not dramatically higher than during the mid to late 1980's when strong yearclasses contributed to the population.



The results from the scientific assessment are in contrast to those from an opinion survey of capelin fixed gear fishers, the majority of whom felt that capelin abundance in 1995 was below average.

Sources of Uncertainty

There are different types of uncertainty within the assessment. The statistical uncertainties, expressed as 95% confidence intervals in the figures, are large, especially for the 1993 yearclass. They express the statistical uncertainty of the model itself but do not include the unquantified statistical uncertainty contributed from the different data sources. Therefore, the illustrated uncertainty is underestimated. Another area of unquantified uncertainty, noted in earlier assessments, is the use of ancillary data from other sources as indices of capelin abundance (e.g. capelin by-catch in groundfish surveys).

Stock status has been difficult to determine in recent years because of the divergence between inshore indices and offshore acoustic surveys. No large-scale acoustic surveys to estimate biomass were conducted in 1995 and the divergence noted in earlier years has not been fully explained. However, new data accumulated each year provide a better basis to evaluate the divergence and stock status. For the acoustic surveys, there is evidence to suggest that poor acoustic detectability, when capelin are dispersed, and unusual geographic distributions in recent years may be contributing to abundance estimates that are lower than the true population size and not comparable to the estimates from the 1980's.

On the other hand, indices of abundance for mature capelin inshore have remained at levels higher than would have been expected from the acoustic surveys. Furthermore, results from surveys that monitor capelin abundance as larvae and one-year-olds are in general agreement with the estimates of relative yearclass strength from the inshore indices during the 1990's.

Outlook for 1996

The 1992 and 1993 yearclasses are expected to be major contributors to the 1996 spawning stock. The results from this assessment show that both yearclasses are strong although, as earlier noted, there is considerable uncertainty in the estimate of the 1993 yearclass. Results from other surveys at early life stages also indicate the 1992 and 1993 yearclasses are relatively abundant. No absolute estimates of these yearclasses presently are available. However, during 1982-89, catches in Div. 3L averaged only 4.3% of the mature biomass projected from the 3L acoustic survey (Shelton et al., 1993). This corresponds to an annual average catch in Div. 3L of 35,000 tons. During the same period, inshore catches averaged 12,000 tons in SA2+Div. 3K. Based on these comparisons and the estimated strength of the 1992 and 1993 yearclasses relative to those in the 1980's, the total TAC of about 33,000 tons in SA2+Div. 3K in the tentative management plan would be less than 10% of the expected mature biomass in 1996.

Capelin of the 1993 yearclass and older captured during fall surveys in 1995 were small and comparable in size to capelin captured in fall surveys in recent years. Based on historical trends in size in the fall and size inshore the following year, capelin in the 1996 stock likely will be small. The overall average size in the spawning stock will also be dependent on the relative proportions of the yearclasses present. During the 1990's, two year old capelin have appeared in high proportions in the spawning stock and have contributed to the small average size. The 1994 yearclass was second behind the 1993 yearclass in relative abundance in a short time-series (1991 - 1994 yearclasses) that monitored abundance of one year-olds. Based on these observations, it would appear that two-year-old capelin may again contribute to a small overall mean size in the 1996 spawning stock.

For More Information

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