DFO Atlantic Fisheries
Stock Status Report 95/4E

Report on the Status of Canadian Managed Groundfish Stocks of the Newfoundland Region

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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.

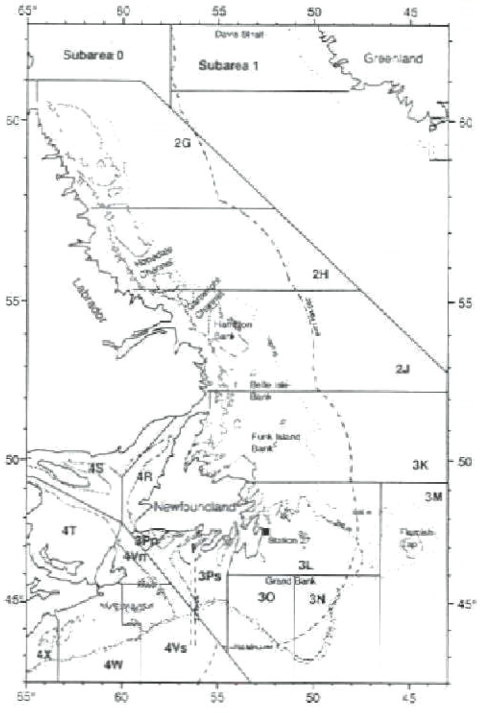
In this area, there are a total of 5 cod stocks (2GH, 2J3KL, 3M, 3NO and 3Ps), 5 redfish stocks (SA2+3K, 3LN, 3M, 3O and Unit 2), 4 American plaice stocks (SA2+3K, 3LNO, 3M and 3Ps), 3 witch flounder stocks (2J3KL, 3NO and 3Ps), 2 Greenland halibut management areas (SA0+1 and SA2+3KLMN), 2 haddock stocks (3LNO and 3Ps), 1 yellowtail flounder stock (3LNO), and 1 pollock stock (3Ps) 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 and SA2+3KLMN Greenland halibut. The NAFO Scientific Council also reviews the Canadian assessment of 2J3KL cod on an annual basis. Greenland halibut in SA0+1 is 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.

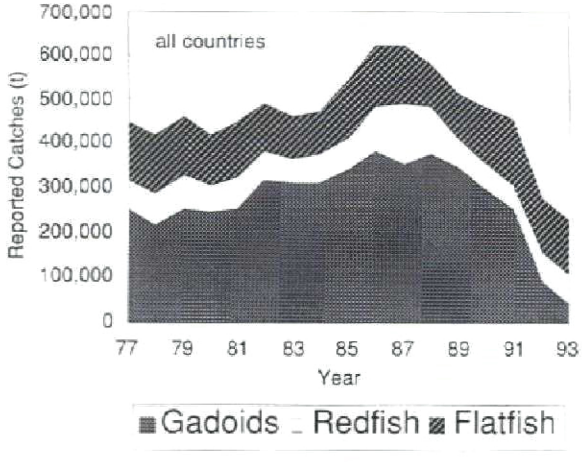
The Newfoundland Region Stock Status Report contains information only for those stocks for which the FRCC provides direct catch recommendations to the Minister. Information on the stocks evaluated and managed by NAFO is contained in separate documentation; the reports of the NAFO Scientific Council.

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.



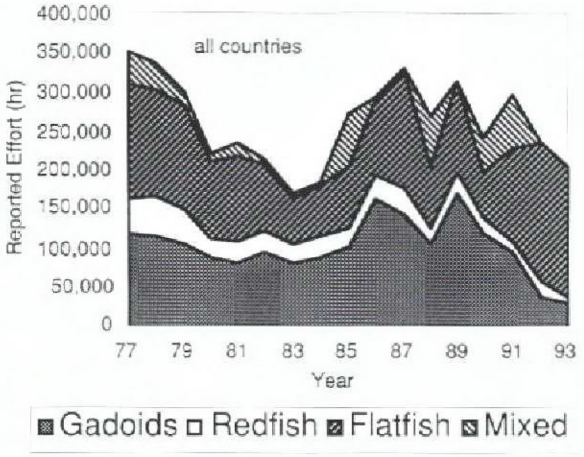
The Groundfish Fisheries

Cod traditionally dominated catches in Newfoundland waters (catches from Flemish Cap (3M) are not included in the figure which shows Canadian and non-Canadian catches from divisions 2GHJ3KLNOPs), but in recent years catches of other species exceeded those of cod. In 1994, the highest catches were of Greenland halibut, taken primarily in the non-Canadian fishery outside 200 miles. Inside 200 miles, the catches were dominated by Unit 2 redfish.



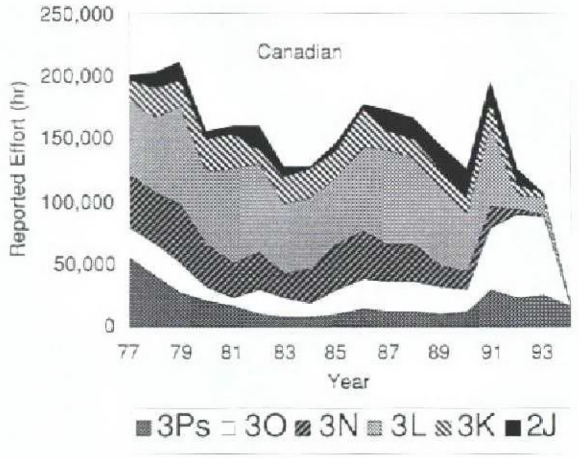
For the Newfoundland area, consistent

information on **fishing effort**, covering all years and most of the catches, is only available from the offshore sector. 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 was for flatfish, specifically non-Canadian effort for Greenland halibut. Some of the non-Canadian effort is also reported as being from 'mixed' fisheries for all three species groups.

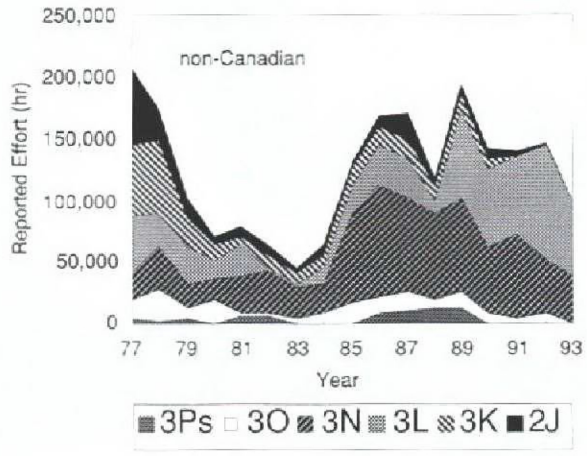


Breaking down the effort by area, and between Canadian and non-Canadian fleets, reveals that during most of the period since extension of jurisdiction, the most offshore Canadian effort took place in Division 3L, while the least was in Division 2J. Although it fluctuated among years, total Canadian reported effort offshore did not change much through the 1980s. Overall, reported effort declined in the early 1990s as a consequence of reduced quotas. During the same period, relative effort increased in Division 3O and Subdivision 3Ps. There was a dramatic decline in Canadian effort in 1994 as a result of the many closures imposed for the first time that year.

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 exerted only in the 'nose' and 'tail' areas of the Grand Banks was about the same as, or even greater than that of the Canadian fleet fishing in the Canadian portion of the Grand Banks in spite of the very great differences in the respective geographic areas.



Although reductions of cod, American plaice, yellowtail flounder, witch flounder and redfish quotas in the Grand Banks area in the 1990s resulted in some reduction of non-Canadian effort in this area, during the same period, the effort directed toward Greenland halibut increased substantially.



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 permitted. Fisheries for lumpfish, monkfish and skates are

also taking place. The remainder of the stocks are under moratoria, restricted to by-catch, or 'test' fisheries only due to low stock sizes.

Groundfish Resource Status

Almost without exception, 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, information suggests that they may be in decline, and reduced TACs were imposed for 1995 as a result.

The amount of scientific information available for monkfish at this point in time is too limited to assess stock status. Some data for skate have been analyzed, and there are indications that the high unrestricted catches from outside 200 miles have had a negative impact on the resource in divisions 3LN. In Division 3O and Subdivision 3Ps, the resource appears to have remained relatively stable through the 1980s and into the early 1990s although there have been some declines in these areas in the most recent years.

Similarly, limited information is available for lumpfish and was reviewed for the first time this year.

For the NAFO managed resources excluding those of Flemish Cap, directed fisheries remain open only for Greenland halibut and 3LN redfish. The NAFO Scientific Council has expressed concern that overfishing on these is gradually reducing stock sizes. Updated information on the status of these resources will be available in June, 1995 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 will therefore be more critically dependent on research activities such as research surveys including those directed toward juveniles, as well as sentinel fisheries.

Other Species Groups

Pelagic Fish Species

Whereas the offshore acoustic estimates of the capelin stock in Subarea 2 + division 3KL have been very low since about 1990. Other indices, including inshore data, have suggested higher abundance during the same period. The reasons for the divergent results remain unclear, and therefore the status has been difficult to determine in recent years. Further work is required to understand these differences as well as the causes for them.

It is also well known that the capelin in this area are smaller at age than in the 1980s. It has been speculated that this may be due to generally colder water temperatures, but the actual cause(s) has not been determined. It is expected that this reduced size will persist for 1995.

The capelin stock in divisions 3NO appears to be at a relatively low level, and the fishery is closed for 1995.

Herring stocks off the east coast of Newfoundland are estimated to be low; with biomasses of only about 10% of the observed maximums. The low stock size is 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.

Stocks of herring off the southeast coast, while considered to be at low levels, are less depressed than those off the east coast.

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). Changes in the distribution of fishing effort during the 1990s indicate that the distribution of shrimp is currently widespread and has possibly been expanding.

Crab landings have been increasing since about 1989, reaching an all time high in 1994. During this period, the distribution of effort has also been expanding and, based on 1994 data, suggests a current wide distribution of crabs throughout the area. Nonetheless, there are some signs of possible future declines. Survey data covering a portion of the total area indicate a declining trend in the catches of pre-recruits. If these declines in the surveyed areas are indicative of a widespread trend, then the biomass will decline as the large stock of commercial sized crab is depleted.

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.

Marine Mammals

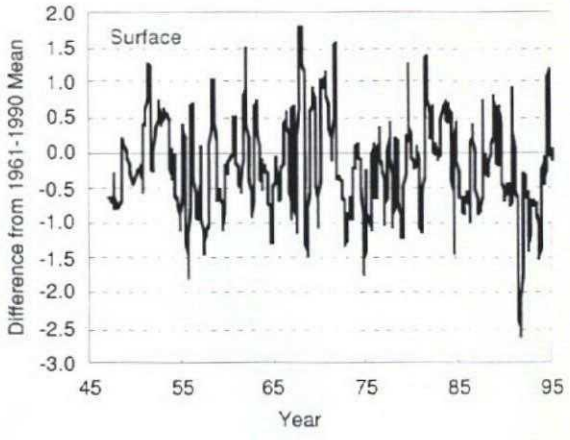
The current estimate of harp seal abundance off eastern Canada (including the Gulf of St. Lawrence) is about 4.8 million animals (95% confidence limits of 4.1 to 5.0 million animals).

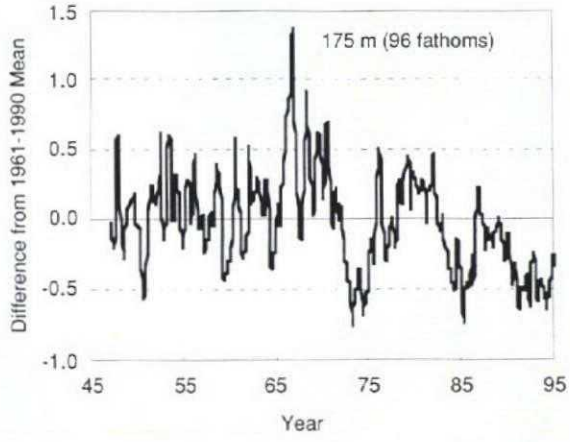
Preliminary estimates of harp seal feeding are now available. For the 2J3KL area, estimates suggest that consumption of all prey combined has increased from about 1.45 million metric tons in 1981 to about 2.79 million metric tons in 1994. In 1994, about 68% of this food consisted of Arctic cod (1.2 million metric tons; 95% confidence interval of 735,000 to 1.7 million metric tons), capelin (620,000 metric tons; 95% confidence interval of 288,000 to 1.0 million metric tons) and cod (88,000 metric tons; 95% confidence interval of 46,000 to 153,000 metric tons). Cod was estimated to make up only about 3% of the total diet in this area.

Caution must be exercised in interpreting these results. Relatively small changes in some of the assumptions used in the model can have significant effects on the estimates. In addition, the seasonal and geographical pattern of sampling may bias the results. While it is believed that the estimates generally reflect the overall amounts eaten, it is premature to speculate on the impacts of harp seals on the population dynamics of the different prey species.

The Environment

The low air temperatures experienced in Atlantic Canada during the winter of 1994 had moderated to near normal by the spring of 1994, and to above normal by summer.





As a result of this warming, surface waters off the east coast of Newfoundland also warmed to above normal during this period. The deeper waters however, remained below normal through the fall.

Although the volume of the cold intermediate layer (CIL) remained somewhat above the longer term average, it was much less than that of the previous 4 years.

Off the south coast, the relatively cold conditions which began around the mid-1980s have moderated somewhat, but below normal temperatures continue, particularly on the eastern portion of St. Pierre Bank, Placentia Bay and in the area of the continental slope.

Ecological Perspectives

An important research activity is that of trying to relate all of the different observations described above; in other words, to look at, and try to better understand the ecosystem. This is a difficult task, and we have a long way to go. However, based on our current information we can begin to see some similarities and differences, and begin to ask questions.

For example, we may ask why so many of the 'traditional' groundfish resources around Newfoundland declined at about the same time. For some of these such as the transboundary Grand Banks stocks of redfish (3LN), cod (3NO), yellowtail flounder (3LNO), witch flounder (3NO) and the southern component of 3LNO American plaice, the cause appears to be more related to overfishing, particularly on the young, immature sizes. The picture does not appear to be as clear for the other stocks. Both fishery and non-fishery causes have been put forward, and the relative importance of each may vary between stocks.

For northern cod, there are differences of opinion. While some strongly advocate that the decline can be fully explained by fishing, others believe there was an important environmental component that must not be ignored.

It is interesting to note that during the early and mid 1980s, research survey data indicated that about $^1/_3$ of the northern cod biomass could be found in each of divisions 2J, 3K and 3L. The declines began earliest, and for a number of years were most severe in the northern area (2J). The cod resource persisted the longest in Division 3L, the most southerly area. In contrast, as has been described above, offshore fishing effort was greatest in Division 3L, and least in Division 2J.

It is well documented that many other commercial and non-commercial groundfish species declined in the 2J3KL area from the early 1980s to the present. For most of these, the declines were greatest in Division 2J. For commercial species other than cod, it is difficult to attribute the declines to commercial fishing because of the relatively low effort, and the magnitude of the declines compared to the reported catches. For example, for American plaice in Subarea 2 + Division 3K, the overall decline in the survey biomass index from 1984 to the present has been about 10 times greater than the total reported catches for the same period. It is difficult to contemplate that discarding for a species more valuable than cod would have been sufficiently high so as to account for these declines.

For redfish, the observed declines are related to continued low recruitment for over 20 years now. In most areas of the northwest Atlantic, good recruitment for redfish is synchronous; that is when good year-classes are born, it generally occurs over a large area. The 1971 year-class was very large in all of the different stock areas. Although good year-classes also occurred in most areas in 1978, 1984 and 1988, this was not the case in Subarea 2 and Division 3K. Information from observers on by-catches of small redfish in the shrimp fishery in the same area do not support the argument that the

shrimp fishery caught stronger year-classes before they had a chance to recruit to the fishery. Very high by-catches of small redfish do occur in the Davis Strait area, but a possible connection between redfish in this area and those further south is not clear.

Observer data from the shrimp fishery for a number of other groundfish species also do not suggest sufficiently high discarding to account for the observed declines.

Some have argued that the declines in non-commercial species are due to by-catches in the directed fisheries, but for that argument to have merit there must be good overlap between areas of directed effort and distribution of the declining species. This does not generally appear to be the case, but more work is required to fully clarify this.

Based on research survey data, the proportion of cod to other groundfish combined actually increased through the 1980s in the divisions 2J3K.

Although there were parallel declines with many groundfish species in the north, in the more southerly areas (3NOPs) preliminary examination of research survey data suggests that changes in the size of different stocks and species did not occur in parallel. Some species declined while others increased. Also, some species such as skate showed different trends in different areas, declining in divisions 3LN but not to the same extent in 3OPs.

Other changes have taken place off the northeast coast. During the 1980s, capelin were found in Division 2J in the early fall, and they slowly migrated south. In recent years, almost no capelin have been found in Division 2J. Also during the 1980s, the offshore acoustic surveys located plenty of capelin and there were reasonable similarities in stock trends suggested by this and other indicators. During the 1990s there has been a yet unexplained divergence between these. Could the environment be affecting capelin distribution and behaviour offshore? As noted above, the growth rates of both capelin and herring have declined, probably due to the colder conditions.

Arctic cod, a cold water species, appears to be increasing in abundance, and its distribution has gradually expanded southward and easterly. It is believed that these movements are also related to colder conditions throughout the area. Arctic cod has become a major component of the biological environment off northeast Newfoundland. It is a major prey of seals, a potential competitor of juvenile cod and capelin, a predator on capelin, and possibly a predator on juvenile cod. Yet its overall role in the ecosystem has been poorly studied.

Unlike groundfish, the fishable stocks of shrimp and crab off the northeast coast appear to be in good shape. It has been speculated that they are doing well because of reduced predation by groundfish, and this may indeed be a significant factor. However, it is interesting to note that the current crab fishery is largely supported by individuals born before observed declines in the major groundfish resources, and even in the absence of high abundance of groundfish, it appears that crab recruitment may be declining. Possible reasons for this are unknown.

The population of harp seals around Newfoundland is increasing. Estimates of their consumption indicate that Arctic cod, capelin, herring and cod make up about 75% of their diet. Of this, cod accounts for about 3%, and cod aged 1 and 2 make up the majority of this.

Outlook

Taken together, all of the above suggest that in addition to man's influence, there may well have been a strong environmental component involved in creating the situation we are faced with today off the northeast coast. Further

south, man's influence has probably had the greatest overall impact.

These apparent differences between areas will influence how the future might unfold. In the southern Grand Banks areas, where fishing appears to have been a significant cause of the declines, closure of the fisheries should result in gradually improving resources. Further north, the closures should also help, but we must also await environmental changes to occur which will result in conditions suitable for a combination of improved recruitment coupled with survival of the fish to maturity.

Recovery may also be influenced by predators such as Arctic cod and seals because of the current low stock sizes.

For More Information

Research Document: Anon. 1995. Report of the Joint ICES/NAFO Working Group on Harp and Hooded Seals. NAFO SCS Doc. 95/16. Ser. No. N2569. 40 p.

Carscadden, J.E. (ed.) 1995. Capelin in SA 2 + Div. 3KL. DFO Atl. Res. Doc. 95/70.

Colbourne, E. 1995. Oceanographic conditions and climate change in the Newfoundland region during 1994. DFO Atl. Res. Doc. 95/3.

Stenson, G.B., M. Hammill, and J.W. Lawson 1995. Predation of Atlantic cod, capelin and Arctic cod by harp seals in Atlantic Canada. DFO Atl. Res. Doc. 95/72.

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DIVISIONS 2GH
COD

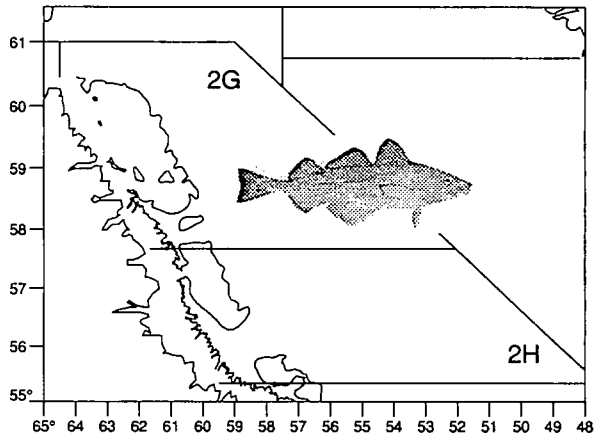
Background

Cod are found on both sides of the Atlantic. In the Northwest Atlantic, cod are distributed from Greenland to Cape Hatteras. It was so important to the New England economy that a carved wooden cod hung in the Massachusetts House of Representatives in Boston. 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. 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 area 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 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 t. 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 has been no reported catch in recent years 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.



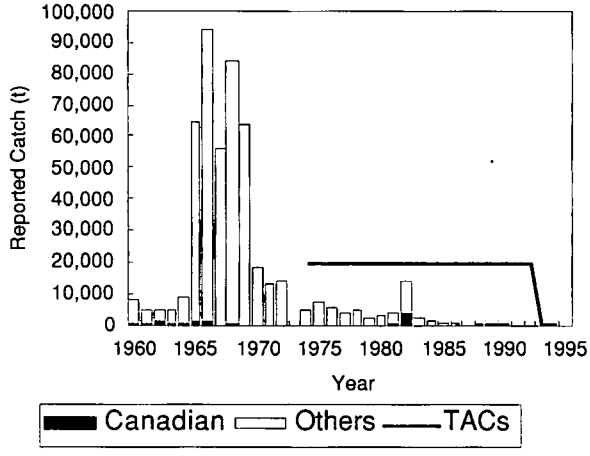
The Fishery

Since 1985, catches have been less than 500 metric tons and there has been no reported catch since 1990. The current TAC of only 1,000 metric tons is not based on any resource assessment. The shrimp and turbot fisheries in this area have reported no significant cod by-catch in recent years.

Landings (thousand metric tons)

Year	60-76 Avg.	77-90 Avg.	1991	1992[1]	1993[1]	1994[1]	1995
TAC	N/A	N/A	20	20	20	1	.2
Can.	.5	.5	0	0	0	0	
Others	26	2	0	0	0	0	
Totals	27	3	0	0	0	0	

[1] Provisional



Resource Status

Assessments of this stock have not been possible in recent years because of the lack of information about the abundance and biomass in the area. Catches have been low or non-existent since 1990, and as a result there is no commercial information 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 problems with the timing of the surveys in that they were conducted during the summer when the cod were inshore. A survey conducted in 1991 attempted to address these problems but this survey detected very few fish.

The shrimp fishery in 2GH discards very few cod. In 1994, bycatch management areas were put in place for the shrimp fishery. The current protocol requires mandatory use of the Nordmore grate in some bycatch areas, and its use in other areas when total groundfish bycatch exceeds 300 kg per day. These measures seem to be quite effective in reducing the bycatch of cod. Estimates from observer data show it has declined from 34 metric tons in 1992 to 1.1 metric tons in 1994.

Outlook

Any rebuilding is dependent on appearance and survival of relatively strong year-classes. The recovery of this stock may also be related to, and dependent upon, events that take place with neighbouring cod stocks. There are possible links with cod in divisions 2J3KL, and recent studies suggest possible past exchange of larval and adult cod between West Greenland and the north Labrador coast. Both of these neighbouring stocks are at low levels at present.

For More Information

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

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NORTHERN (2J3KL) COD

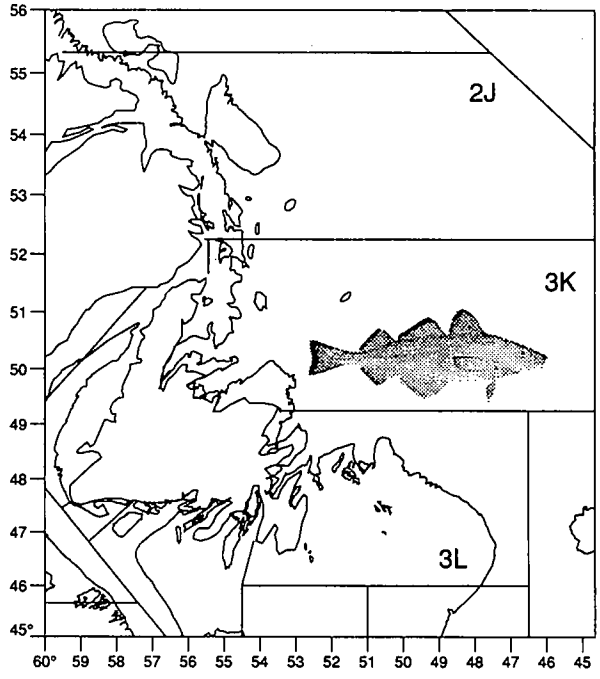
Background

Cod are found on both sides of the Atlantic. In the Northwest Atlantic, cod are distributed from Greenland to Cape Hatteras. It was so important to the New England economy that a carved wooden cod hung in the Massachusetts House of Representatives in Boston. 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

Until recent years the northern (NAFO divisions 2J3KL) cod stock was one of the largest in the world and of vital importance to the economics 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 areas. Cod from this stock are slow growing relative to more southern areas. An age 5 cod would be about 50 cm.(about 20 inches) long. Throughout the area female cod begin to mature at about 4 years of age with males maturing at age 3. Cod are very prolific. A female cod aged six years could produce about one million eggs per spawning. However, very few of these would survive to complete the life cycle to maturity because of a tremendously high mortality rate. Cod feed on a wide variety of items but as adults take mainly capelin.

This stock has supported a commercial fishery since the 16th century. Prior to the 1960s the catches were between 200,000 and 300,000 metric tons annually. 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 since declined. The decline has been substantial in recent years to a very low level, probably to about 1% of that in the early 1980s. A moratorium on fishing has been in effect since July, 1992.



The Fishery

The stock declined in the mid 1970s due to very high catches during the 1960s. As a result, TACs and catches also declined. By the mid- to late- 1980s, the stock had increased in size, and catches peaked at about 250,000 t.

Landings (thousand metric tons)

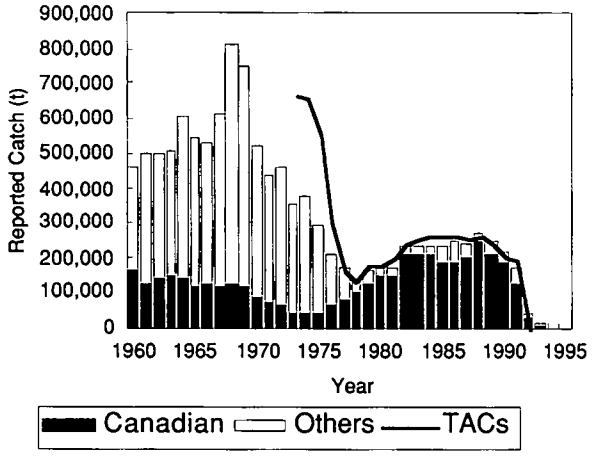
Year	62-76 Avg.	77-90 Avg.	1991	1992[1]	1993[1]	1994[1]	1995
TAC	N/A	N/A	190	0[2]	0	0	0
Can. Ins.	97	92	60	12	9	1	
Can. Off.	7	83	60	17	+	0	
Others	386	38	51	14	2	+	
Totals	490	213	171	43	11	1	

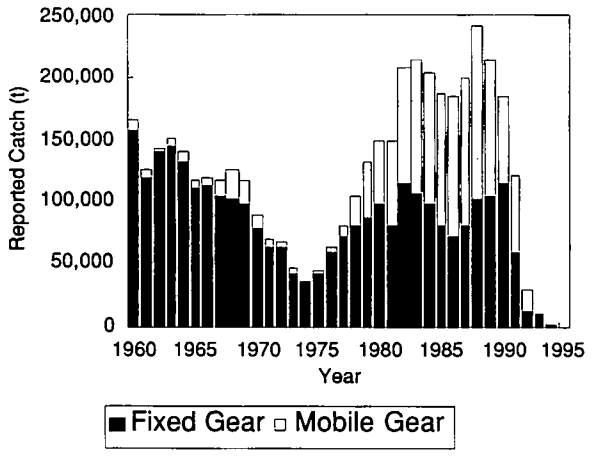
[1] Provisional
[2] Moratorium imposed July 2, 1992

The rapid decline of the resource in the 1990s led to reduced TACs, and eventually to a moratorium on commercial fishing being declared on July 2, 1992. People were still allowed to catch cod for personal consumption.

The moratorium was extended to include all types of fishing in January, 1994 although a restricted food and subsistence fishery was

permitted during Aug.-Sept. of 1994. This fishery took approximately 1,300 metric tons in 1994 mainly from NAFO divisions 3L and 3K. However, the fishery was generally considered a failure as catch rates were low and cod generally small. Age 4 and 5 year old cod were the most abundant in the catch. The foreign catch outside of 200 miles in 1994 was estimated by Canadian Surveillance to be about 50 t.

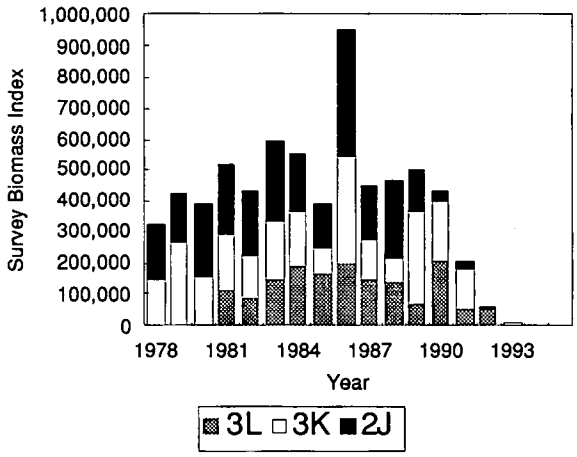




Resource Status

Current **stock status** was estimated mainly using trends in abundance and biomass indices from annual bottom trawl and acoustic surveys as well as limited fishery information.

Autumn research vessel survey indices of cod **biomass and abundance** in divisions 2J3KL have indicated severe declines in recent years, and the 1994 point estimates are the lowest in the time series. No aggregations of fish were found. Cod older than age 7 were virtually absent in the autumn surveys of 1993 and 1994.



Survey results indicate that the decline occurred earliest in the Division 2J, and it has been substantial each year since about 1990.

Anecdotal information from the **food fishery** in September, 1994 indicated that there were no areas with reports of "good" catch rates comparable to those experienced in the years prior to 1992. The majority of the catch since the beginning of the moratorium has come from inshore areas where it has been shown that separate stock components are likely to exist, mainly in the deepwater bays.

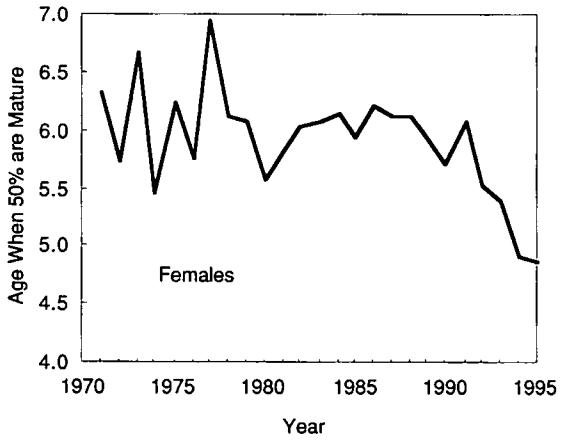
During the June, 1994 **acoustic study** there were no large catches comparable to those obtained during the 1990-1993 surveys. No high density aggregations of adults were located as had been the case in previous years.

During May, 1995 a body of cod was located in **Smith Sound, Trinity Bay**. Based on 2 acoustic surveys of the area, it was determined that between 10,000 and 20,000 metric tons were present in the area, and that they were mainly larger mature fish close to spawning. Although staff from the Department and Memorial University has worked in this area for many years, they had never before seen such a large body of fish at this time of year. On the

other hand, local fishers claimed that this discovery did not represent anything unusual and that cod were present in the area every winter. Results of analysis of antifreeze levels in the blood of sampled cod by researchers at Memorial University indicated that the cod had not been present in the cold waters of Smith Sound for very long, but had moved from warmer more offshore waters recently.

Condition factors as measured by body weight relative to length declined from 1989 to 1992 in Division 2J and to a lesser extent in Division 3K. There was no apparent decline in Division 3L. This pattern was reflected in changes in the overall level of feeding of cod during the same time period, particularly for Division 2J. The declining trend in condition appears to have reversed in 1993 and 1994, but his was not reflected in the feeding data for the same period.

Since about 1990-91, the age at which 50% of cod have been **maturing** has been declining. The values for 1994 were the lowest in the time series. This may be a response to population declines.



Changes in **growth rate** and **proportion mature** at age are important in the determination of the amount of recruitment necessary for **spawner biomass replacement** i.e. for year-classes to produce sufficient spawner biomass to equal that of their parents. Based on the most recent assessment results, it was concluded that the decrease in recruitment and growth rates over the 1980s played a major role in the stock decline.

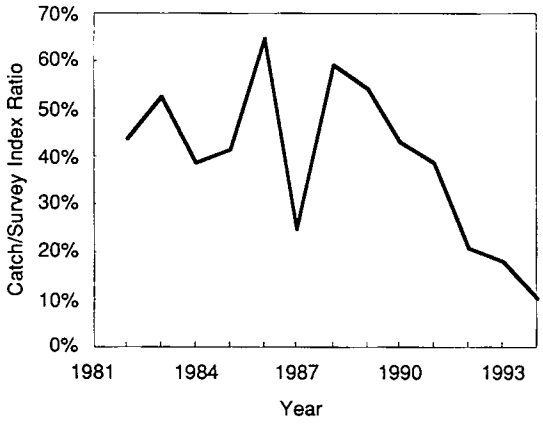
During the food and subsistence fishery in divisions 2J3KL in 1994, it was generally observed by fishermen that cod were of average condition. There were some reports of 'thin' fish observed in some areas during the similar 1993 fishery but the extent of these observations is unknown.

Based on the research survey data, average **lengths and weights at age** for the dominant age groups (4 to 7) declined for most years from the late 1970s and early 1980s until 1992, with declines most pronounced in Division 2J. There were general increases in 1993 and 1994.

Estimates of the abundance of **pre-recruits** (ages 0 to 2) were obtained in recent years using a variety of indices. Although the precision of the estimates requires further investigation, the 1994 year-class appears to be stronger than the 1992 and 1993 year-classes. The 1993 year-class also appears stronger than those of 1991 and 1992. The 1991 year-class appears to be the poorest of the four. It will be at least 3 years before this can be verified from the offshore research vessel surveys.

Analysis of tagging concluded, as did previous assessments, that **fishing mortality** in the late 1980s and early 1990s was high. Since the moratorium, fishing mortality would have been reduced in the offshore areas as catches were very low.

An analysis of the ratio of the catches to survey biomass indices indicated that there were high fishing mortalities associated with the limited food fisheries and foreign fishery after declaration of the moratorium, but did not support results of other analyses which estimated high and increasing fishing mortalities in the years immediately prior to the moratorium.



Mortality of cod in the northern shrimp fishery, although unknown, declined from 1992 to 1994 as a result of the introduction of the Nordmore grate.

Ecological Factors

Harp seal numbers have increased substantially since the early 1980s and their consumption of cod as well as other fish species has increased. Information on their feeding indicates that cod make up about 3% of the diet of harp seals. Fish aged 1 and 2 dominate.

Ocean conditions in 1994 were closer to the long-term average than in recent years. This may be beneficial for things such as growth rates.

Outlook

All indices available indicate that this stock is still at an **extremely low level**. The finding, in 1995, of 10,000 to 20,000 metric tons of mature cod in Trinity Bay is exciting in that it indicates that some spawning stock remains. However, it is important to remember that this biomass is still very low compared to the historical spawning stock size which was in the range of one million metric tons.

The reasons for the drastic decline in recent years remain unresolved. Stock reduction since the moratorium has occurred although catches have been much reduced. Projections of recovery time are not possible until there is evidence of the presence and survival of a substantial year-class. The increasing trend in pre-recruit indices is encouraging, but it is premature to base any predictions on their strengths.

For More Information

Research Document: Bishop, C.A., D.E. Stansbury and E.F. Murphy. 1995. An update of the status of Div. 2J3KL cod. DFO Atl. Res. Doc. 95/34.

Bishop, C.A., J.T. Anderson, E. Colbourne, G.R. Lilly, R.A. Myers, G.A. Rose, D.E. Schneider and D.E. Stansbury. 1995. Cod in NAFO Division 2J3KL. NAFO SCR Doc. 95/9. Ser. No. N2575.

Kulka, D.W. 1995. Bycatch of commercial groundfish species in the northern shrimp fishery. DFO Atl. Res. Doc. 95/48.

Kulka, D.W., R. Stead, D. Lane and L. Russell. 1995. Summary of the food fishery for cod in NAFO divisions 2J, 3K, 3L and 3Ps. DFO Atl. Res. Doc. 95/47.

Morgan, M.J. and P.A. Shelton. 1995. Alternative models of maturity at age applied to cod in Divisions 2J3KL. DFO Atl. Res. Doc. 95/ 24.

Ruzzante, D.E., C.T. Taggart, D. Cook and S. Goddard. 1995. Genetic differentiation between inshore and offshore cod (*Gadus morhua* L.) off Newfoundland: microsatellite DNA variation and antifreeze level. DFO Atl. Res. Doc. 95/23.

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SUBDIVISION 3Ps COD

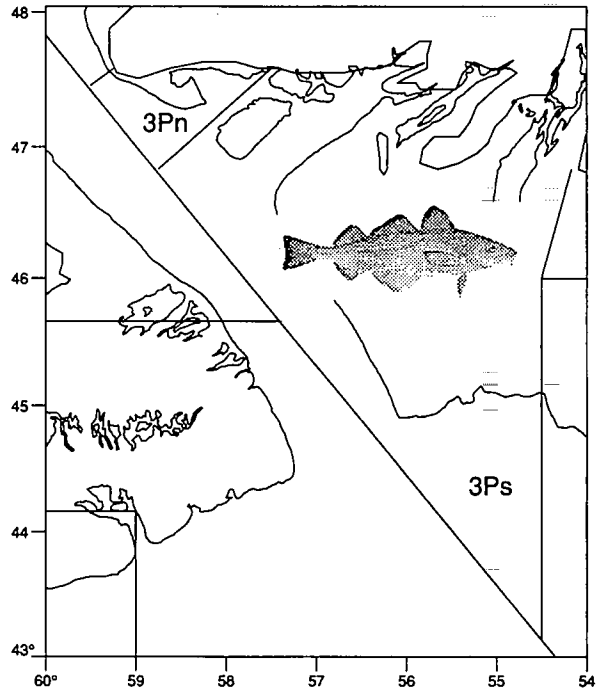
Background

Cod are found on both sides of the Atlantic. In the Northwest Atlantic, cod are distributed from Greenland to Cape Hatteras and are managed as 12 stocks. The 'St. Pierre Bank' stock occurs along the south coast of Newfoundland mainly between Placenta Bay west to Hermitage Bay and on the offshore Banks from Burgeo Bank in the west to Green Bank in the east.

The stock overwinters mainly in the deeper water of the slopes of St. Pierre Bank. A large proportion of these cod migrate inshore in early summer and are then liable to capture by inshore gears.

Cod from this stock are generally faster growing than those in the more northerly areas. Throughout the area female cod begin to mature at about 4 years of age with males maturing at age 3. Cod are very prolific spawners. A female cod aged six years could produce about one million eggs per spawning. However, very few of these would survive to complete the life cycle to maturity because of a tremendously high mortality rate. Cod feed on a wide variety of items, but as adults take mainly capelin.

Catches from this stock have mainly supported an inshore fixed gear fishery for centuries and have been of vital importance to the area. A moratorium on fishing has been in effect since August, 1993.



The Fishery

After the extension of jurisdiction in 1977, cod catches averaged slightly over 30,000 metric tons until the mid-1980s when catches by France increased significantly such that total landings peaked at about 57,000 metric tons in 1986 and 1987. Catches then declined to about 37,000 metric tons through 1991 before dropping to 32,000 metric tons in 1992. Fishing area restrictions due to the boundary dispute have led to fluctuations in the French catch since the late-1980s. The 1993 TAC was reduced and access by French vessels to Canadian waters was restricted.

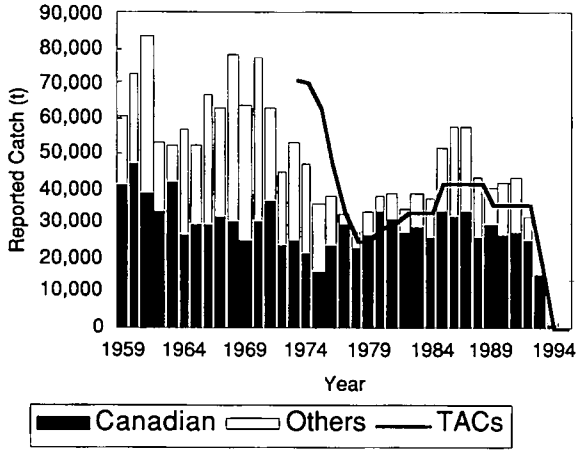
Landings (thousand metric tons)

Year	59-76 Avg.	77-90 Avg.	1991	1992[1]	1993[1]	1994[1]	1995
TAC	-	-	35	35	20	0	0
Can.	30	29	21	24	15	.6	
Others	28	11	16	7	+	0	
Totals	58	40	37	31	15	.6	

[1] Provisional

There was no offshore French fishery in 1993. The total 1993 catch was 15,000 metric tons,

the lowest in the time series to that time, with the majority being obtained in the Canadian inshore fixed gear fishery.

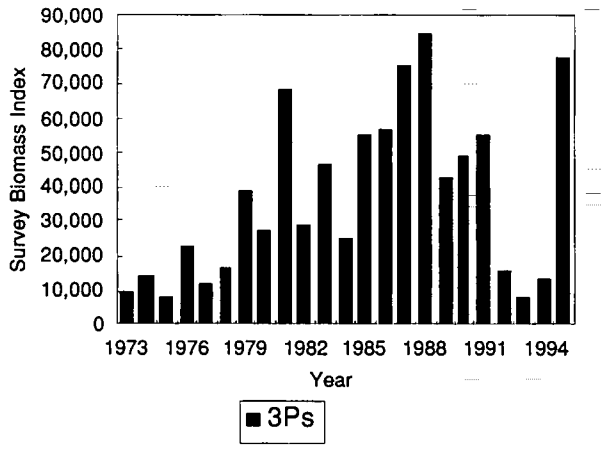


Based on the recommendations of the FRCC, the fishery was closed by the Canadian government in August 1993. A recreational food fishery was permitted for a total of 8 days in 1994. About 480 metric tons of cod were taken before this fishery was closed in 1994 while a further 165t was taken as by-catch in other fisheries. However the fishery was generally considered a failure as catch rates were low and cod generally small. The 1989 year-class (age 5) was most abundant in the total catch.

Resource Status

Current stock status was estimated mainly using trends in the **abundance and biomass indices** from Canadian bottom trawl surveys as well as limited fisheryinformation.

Results from the survey series have been highly variable. The biomass index from Canadian surveys showed an increasing trend in the mid-1980s followed by a decline in 1989. Results for 1992-1994 were among the lowest observed in the 1978-94 time series. The 1994 survey results indicated an increase in the index to approximately 15,000 metric tons. The abundance index followed a similar pattern.



Biomass and abundance from the 1995 survey were substantially higher than those of recent years. However, this resulted from the occurrence of one large cod catch in a small portion of the survey area toward the edge of the Bank in the Halibut Channel area. The two tows conducted in this area obtained catches of 19.5 kg (35 pounds) and 14,699 kg (26,750 pounds) respectively. The biomass estimated for this stratum was 71,260 metric tons, 91% of the total for the whole survey area.

With the exception of that for 1995, surveys since 1991 have suggested that there has been a decline in the resource from levels estimated for the late-1980s. Although there were some questions concerning the reliability of the research surveys as indicators of stock abundance, they suggested that the resource was at a low level. This was consistent with declining length at age, increased total mortality estimated from survey catches and a loss of older age groups. Similar to stocks in adjoining divisions, 3Ps cod appeared to have declined since the mid-1980s.

The 1989 year-class was the most abundant in the 1995 survey, as it had been in 1993 and 1994. Relatively low abundance at the earlier ages indicates that following year-classes are not strong. However, analysis indicates that not much confidence can be placed in the results

from the 1995 survey because of the impact of the single, large catch.

An **acoustic survey** conducted in the inner portion of Placentia Bay in early 1995 did not detect large numbers of cod. However, the timing of the survey (10 days during the Jan. 23 - Feb. 23 period) was probably not the most appropriate.

Anecdotal information from the **food fishery** in September of 1994 indicated that there were no areas with reports of good catch rates comparable to that experienced in the years prior to 1992. During this fishery in 3Ps, it was generally observed by fishermen that cod were of average condition. There were some reports of 'thin' fish observed in some areas during the similar 1993 fishery but the extent of these observations is unknown.

A **sentinel fishery** has been conducted at 12 sites along the south coast of Newfoundland from St. Brides to Ramea, since late February of 1995. Gear types used were either gillnet or longline. Only preliminary catch rate information could be provided at this time. Although similar data was not available for other years for comparison, observations of fishermen indicate that catch rates at the sites surveyed were as good or better than they were prior to the closure of the fishery in 1993.

Information provided by Fisheries Management indicated that by-catch of cod has been a larger problem in some groundfish fisheries during 1995 and a number were closed as a consequence.

Concerns were expressed during the 1994 assessment of this stock with respect to stock structure. During the 1995 surveys no concentrations were found in the western part of the stock area adjacent to the 3Pn4RS area, while the single large catch was obtained reasonably close (about 30 mi.) to the border with Division 3O. Data relative to the portion of the stock occurring in Placentia Bay did not suggest the existence of large numbers although questions remain concerning migrations in the area. Consequently, a clearer definition of the stock unit is still necessary.

Ecological Factors

Since 1991, bottom water temperatures from surveys have generally increased from the lows experienced during the mid-1980s and in 1990, but large spatial areas with negative temperature anomalies have continued into the spring of 1994, particularly on the eastern portion of St. Pierre Bank, on the continental slope areas and in Placentia Bay. Possible impacts of these changes have not been determined.

Outlook

Index biomass estimated from the 1995 survey suggests that the stock has improved dramatically. However, a very cautious approach to interpretation of these results is necessary considering the basis for the survey estimate. The age structure determined from the survey does not indicate that the apparent increase in 1995 is due to increased recruitment. The stock is very likely closer in size to that estimated for 1992-1994. The very large survey catch in 1995 may have resulted from factors affecting catchability, such as strong temperature gradients. Without corroborating data, the 1995 estimate must be treated with caution. However, evidence of increased by-catch problems in other directed fisheries such as those for redfish, skate and hake, and the perceived good catch rates reported from the sentinel fishery are not indicative of a further stock decline.

Cod from the 1989 year-class are now mostly mature and should be protected as no other year-classes are prominent in the spawning biomass.

For More Information

Research Document: Bishop, C.A., E.F. Murphy and D.E. Stansbury. 1995. Status of the cod stock in NAFO Subdivision 3Ps. DFO Atl. Res. Doc. 95/31.

Davis, M.B. 1995. Preliminary results from the inshore sentinel fishery in Subdivision 3Ps. DFO Atl. Res. Doc. 95/67.

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DIVISIONS 3LNO HADDOCK

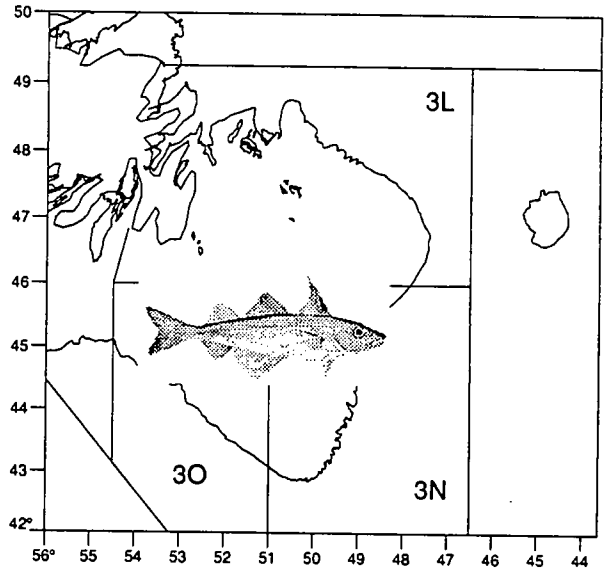
Background

Haddock occurs on both sides of the North Atlantic.Along the coast of North America, 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. 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 attain 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. 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. 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 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 in 1961. These catches were supported by the presence of the strong 1949 and 1955 year-classes. Landings have 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, and have since declined to less than 1,000 metric tons.

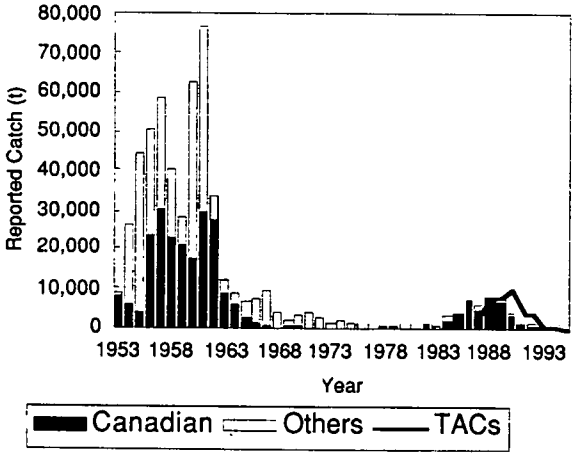
Landings (thousand metric tons)

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

[1] Provisional
[2] By-catch only

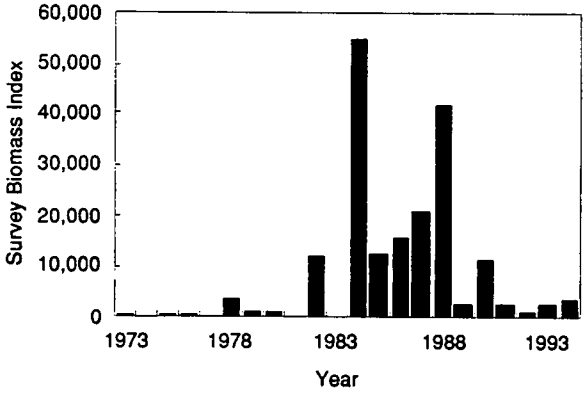
The provisional catch for 1994 was only 8 metric tons, and this is the lowest catch on record. This was partially due to the moratorium

on cod and flatfish stocks in the divisions 3LNO area imposed for 1994 by NAFO.



Resource Status

Research surveys have been conducted to the area since the early 1970s, but coverage in the 1970s was not as extensive as the more recent period. Abundance and biomass indices of haddock from spring Canadian research vessel surveys were low from 1973 through 1981 after which both increased substantially. The increases were due to growth of the relatively strong 1980 and 1981 year-classes. Very few haddock were ever found in Division 3L during the spring surveys.



The **biomass index** was highest in 1984, declined sharply in 1985, then showed a gradual increase to 1988. The index has been low since.

Abundance at age information 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. The NAFO moratorium on the cod and flatfish fisheries will probably result in lower fishing mortality.

Ecological Factors

Haddock in Newfoundland waters are thought to be at the northern extension of their range in the Northwest Atlantic. Oceanographic data presented for 1994 show water temperatures on the plateau of the Grand Bank were below long term means. The colder conditions throughout the area in recent years have probably impacted their distribution and behaviour.

Outlook

There have been no signs of improved recruitment 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 reach 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. Res. Doc. 95/33.

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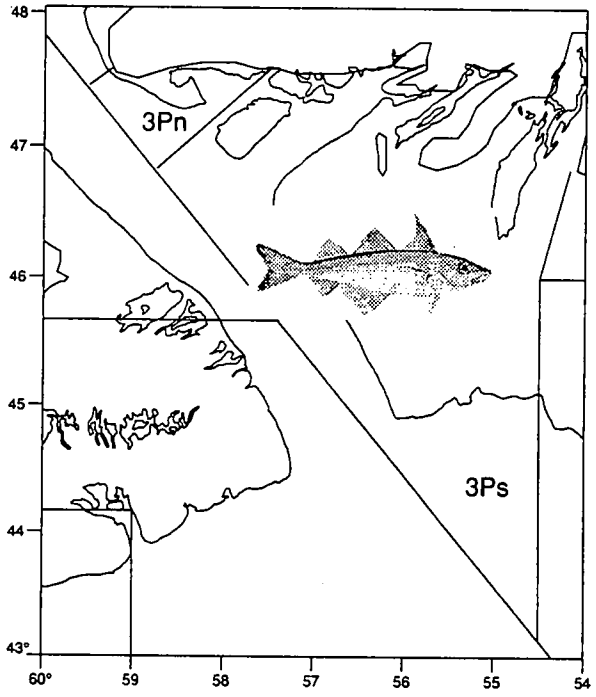
SUBDIVISION 3Ps HADDOCK

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.

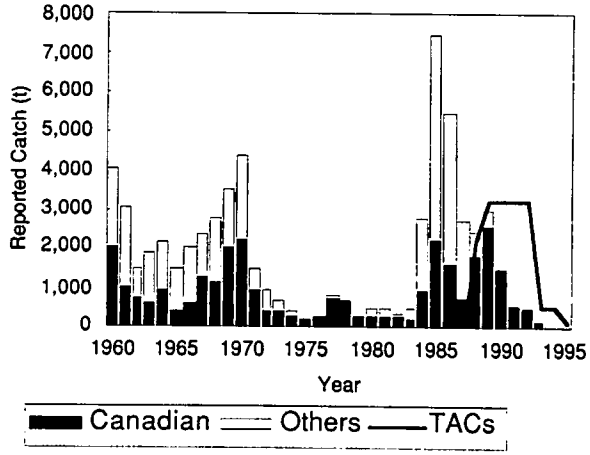
Haddock are primarily bottom feeders and food varies with size. Those less than 50 cm (20 inches) eat crustaceans, in particular amphipods, pandalid shrimp and hermit crabs. Also a part of the diet are echinoderms (brittle stars, sea urchins and sand dollars), Mollusks, (snails and clams) and annelid 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. Catches since 1960 have been mainly in the 1,000 to 2,000 metric tons range, increasing to 7,500 and 5,400 metric tons in 1985 and 1986. This increase was mainly due to increased effort by France. Provisional catch for 1994 is 21 metric tons which is the lowest on record. This is partially due to the moratorium on cod established by Canada in 1993.



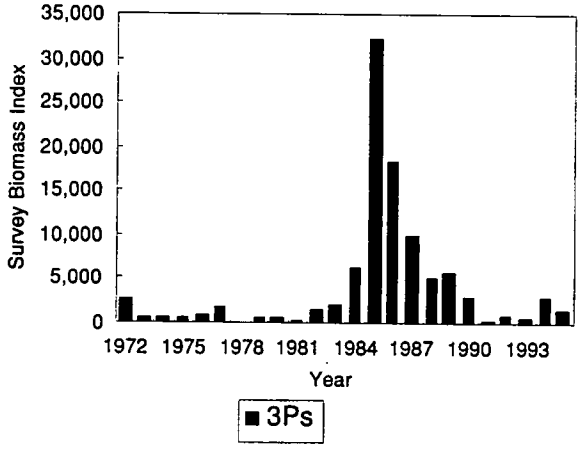
Landings (thousand metric tons)

Year	60-76 Avg.	77-90 Avg.	1991	1992[1]	1993[1]	1994[1]	1995
TAC	-	-	3.2	3.2	.6[2]	.5[2]	.1[2]
Can.	.9	.8	.5	.5	.1	+	
Others	1	.8	0	0	0	0	
Totals	10	2	5	5	1	+	

[1] Provisional
[2] By-catch Only

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 will reduce 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 and behaviour. In explaining year-class survival, Templeman noted that probably the most significant factors are water currents. Young haddock develop along the slopes of St. Pierre Bank and the southern part of the Grand Bank, where waters close by to the south are too deep and often bottom temperatures to the north are too cold for haddock. In some years, in the summer bank waters circulate mainly on the bank and larvae can settle in suitable conditions. In other years the bank water is caught up in eddies of the Gulf Stream and larvae settle in waters too deep. Temperatures on St. Pierre Bank have been below normal for a number of years and the chances of year-class survival may have been further reduced.

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. If the approach of allowing fish to at least reach spawning age is adhered to, recruitment should be enhanced.

For More Information

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SUBAREA 2 + 3K AMERICAN PLAICE

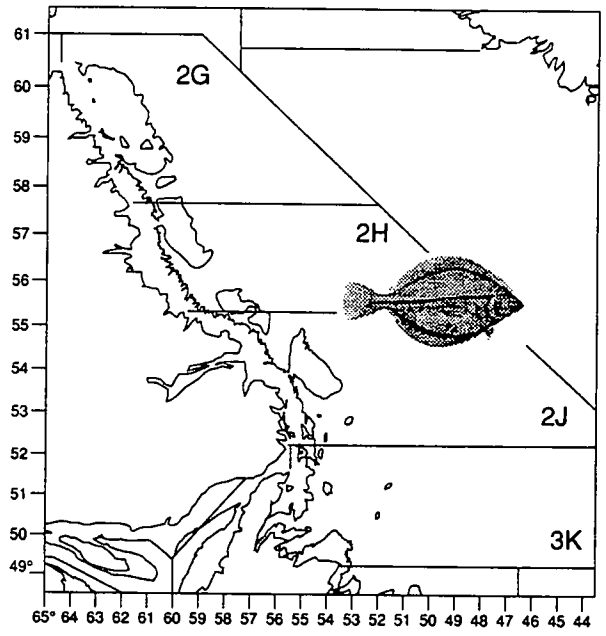
Background

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 usually found to be most abundant at depths less than 250 m, although there has been a shift to deeper water since the late 1980s.

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

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

After the declaration of the 200 mile limit in 1977, non-Canadian 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 catch 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.



The Fishery

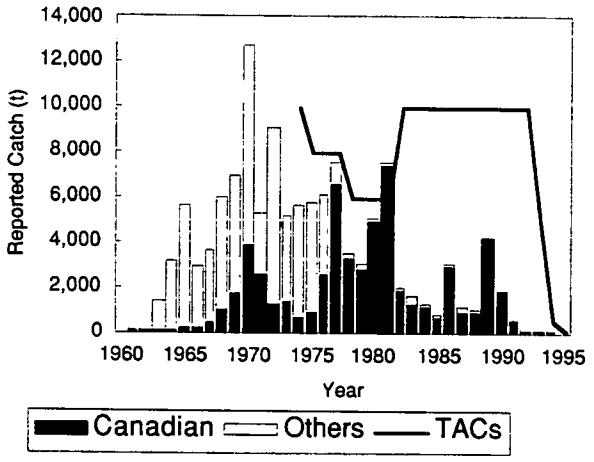
Catches from 1992 to 1994 averaged less than 100 metric tons per year, and are by far the lowest in the time series, due in part to the moratorium on the northern cod fishery, and drastic reductions in the TAC in 1994.

Landings (thousand metric tons)

Year	60-76 Avg.	77-90 Avg.	1991	1992[1]	1993[1]	1994[1]	1995
TAC	N/A	N/A	10	10	5	.5[2]	.1[2]
Can.	1	4	.5	.1	.1	.1	
Others	3	.2	+	0	0	0	
Totals	4	4	.5	.1	.1	.1	

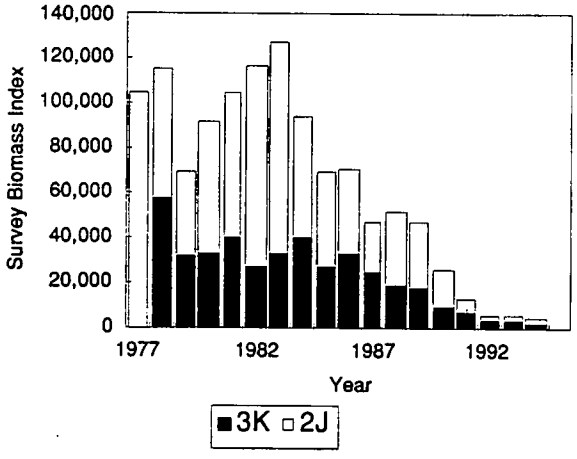
[1] Provisional
[2] By catch only

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 opted to fish for American plaice in the southern divisions of Subarea 3.



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 1994 when catches were very low, data are either non-existent or inadequate to estimate the commercial catch at age.

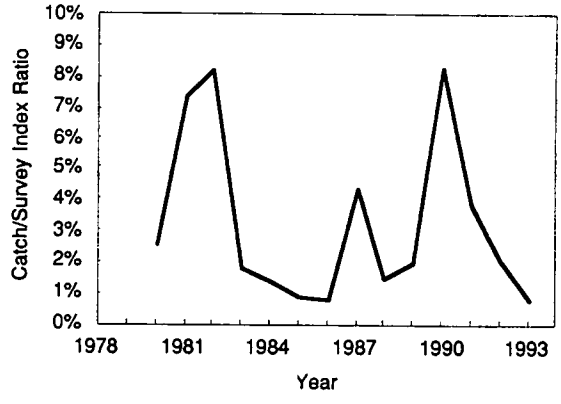


Research vessel survey information shows that the stock is currently at a very low level. In all surveyed areas, the **index of biomass** declined substantially between the early 1980s and the early 1990s.

Shifts in the depth distribution of American plaice to deeper water occurred during 1986 to 1989 in both divisions 2J and 3K, and were followed by rapid, severe declines of the stock. In divisions 2J and 3K combined, the 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

There has been a gradual reduction in the maximum age of American plaice caught during 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 1993, and current estimates of **spawning stock size** 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 1994 survey are not available at this time.

It is clear from the research vessel survey data that this stock has declined to an extremely low level in recent years. 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.

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 size remained at a low level from 1991 through 1994.

The prospects for rebuilding in the **longer term** are unknown, although a recovery of the stock is unlikely before 10 to 15 years. The 1995 TAC of 100 metric tons is for by-catch only, with no provision for a directed fishery. Any fishery in 1996 could be detrimental to stock rebuilding.

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. Res. Doc. 95/35.

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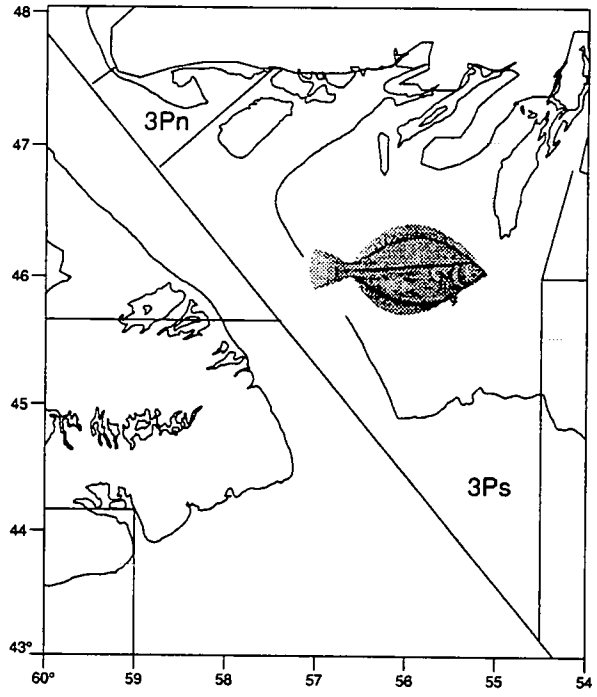
SUBDIVISION 3Ps AMERICAN PLAICE

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 Subdivision 3Ps were usually found to be most abundant at depths of from 100 to 200 m but there has been a shift to deeper waters since the late 1980s.

American plaice in NAFO Subdivision 3Ps enter the otter trawl fishery at age 5. The bulk of the fishery is comprised of fish aged 8 to 12 with some fish up to age 18 being caught even in most recent years despite declines in stock size. Female American plaice in 3Ps mature at about age 9 while males mature at about age 5.

Catches from this stock were highest from 1968 to 1973, during which time they averaged over 10,000 metric tons. Since 1980, catches have exceeded 5000 metric tons only twice. There have been both offshore and inshore fisheries but in most years the majority of the catch is taken by the offshore otter trawl fleet. The first quota was put in place in 1974 at 11,000 metric tons. The quota was 5,000 metric tons through the 1980s, then reduced to 4,000 metric tons for 3 years before being set at 3,000 metric tons for 1993.



The Fishery

Catches from this stock were highest from 1968 to 1973, exceeding 12,000 metric tons on three occasions in this period. Catches by foreign vessels peaked at about 8,800 metric tons in 1968, due mainly to the USSR catch, but have not exceeded 800 metric tons since 1973. The catch in 1993 was 751 metric tons, the lowest since the early 1960s.

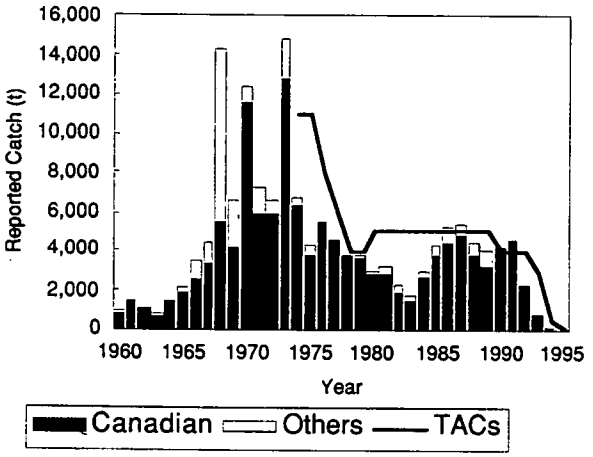
Landings (thousand metric tons)

Year	60-76 Avg.	77-90 Avg.	1991	1992[1]	1993[1]	1994[1]	1995
TAC	-	-	4	4	3	.5[2]	.1[2]
Can.	4	3	5	2	.8	.1	
Others	1	.3	0	+	0	0	
Totals	5	6	5	2	.8	.1	

[1] Provisional
[2] By-catch Only

Based on a recommendation by the FRCC, the fishery was closed in September of 1993 for the remainder of that year. The TAC for 1994 was set at 500 metric tons to allow a by-catch in other fisheries. Total catch in 1994 was 117

metric tons. There is by-catch quota of 100 metric tons in place for 1995.

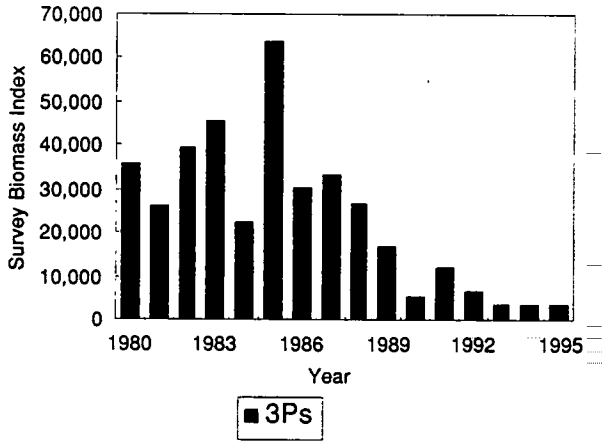


Resource Status

In 1993, the catch was comprised mainly of fish aged 8-12, similar to most years. No recent catch rate data are available from offshore otter trawlers due to very low catches and closure of the fishery in 1993. Reports from the fishing industry indicated very poor catch rates in this fishery in 1993.

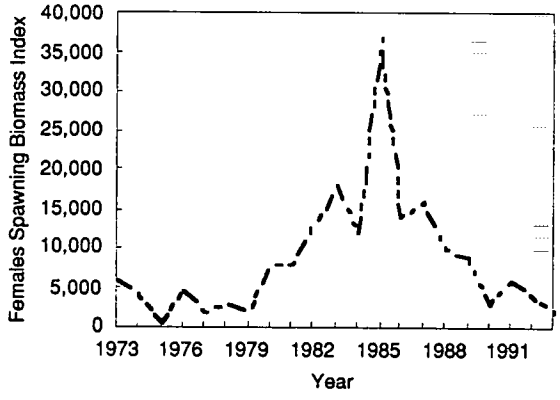
Research vessel survey information shows that the stock is at a very low level. The **biomass index** has declined to 10% of the level of the mid-1980s. The major declines occurred at a time when fishing pressure was low. Increased effort in the early 1990s may have hastened subsequent declines.

The 1995 survey gave a biomass index of 3,944 metric tons. Most of the biomass in recent surveys has been in deeper areas than usual.



The **abundance** of all age groups has declined and there has been a decrease in **recruitment.** Age composition data from the 1994 and 1995 surveys are not yet available, but abundance at length from these surveys does not indicate any increase in young fish.

The female **spawning stock biomass index** has been declining since 1985, with the 1993 estimate of 1,900 metric tons being the lowest since 1975.



As was noted in the 1994 Stock Status Report, there has been a dramatic decline in age at 50% maturity since the early 1970s for both males and females.

Ecological Factors

Water temperatures have been below normal in Subdivision 3Ps since the mid-1980s. Although conditions moderated somewhat in 1994,

temperatures continued to be below normal particularly on the eastern portion of St. Pierre Bank and in the area of the continental slope. It is unclear how these conditions may have impacted on the resource.

Outlook

The outlook is very **pessimistic**, given the current low stock size, and the lack of recruitment indicated by the surveys. In the short to medium term, there is little prospect for stock rebuilding. Any catch in 1996 would be detrimental to the stock.

For More Information

Research Document: Morgan, M.J., W.B. Brodie and G.T. Evans. 1995. Assessment of the American plaice stock in NAFO Subdiv. 3Ps. DFO Atl. Res. Doc. 95/36.

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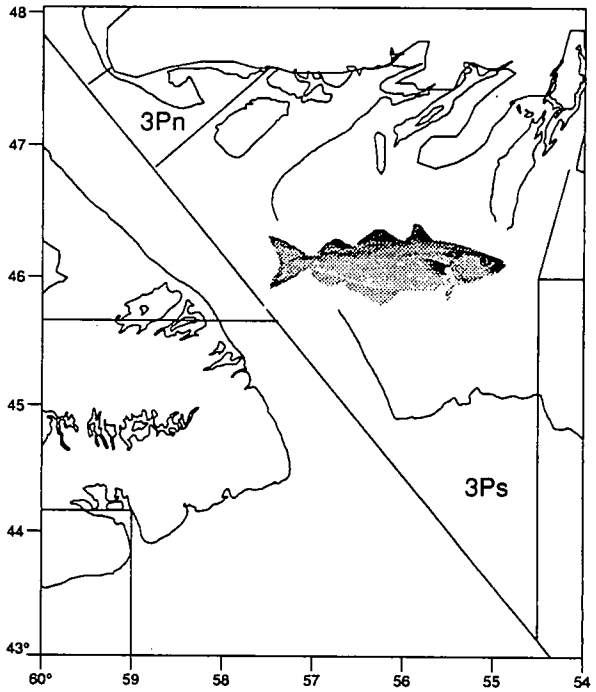
SUBDIVISION 3Ps POLLOCK

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.

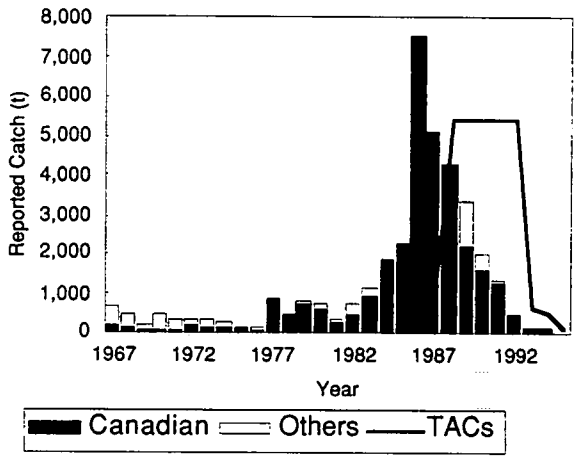
Pollock are a cold water fish preferring waters from 0° C to 10° C. However maturation of sex organs and incubation of eggs requires temperatures in the upper range. This fact places Newfoundland waters at the northern end of pollock range. Research on pollock in the Newfoundland area shows that mature 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

Catches of pollock in Subdivision 3Ps are generally low, having been 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.



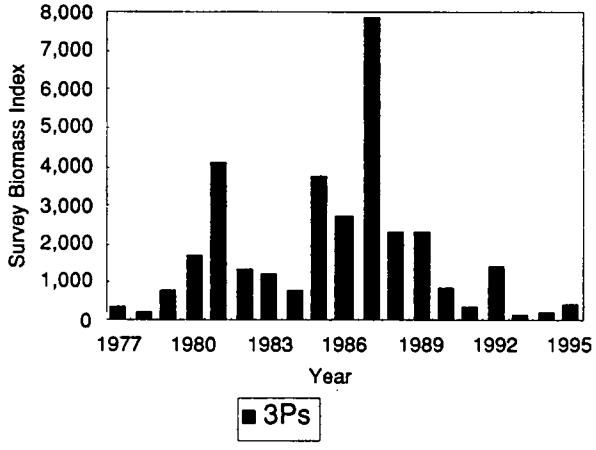
Landings (thousand metric tons)

Year	67-76 Avg.	77-90 Avg.	1991	1992[1]	1993[1]	1994[1]	1995
TAC	-	-	5.4	5.4	.6[2]	.5[2]	.1[2]
Can.	.1	2	1	.5	.1	.1	
Others	.2	.2	+	0	0	0	
Totals	.3	2	1	.5	.1	.1	

[1] Provisional
[2] By-catch Only

Resource Status

Research vessel surveys have been conducted in NAFO Subdivision 3Ps since 1972 by Canada. The **biomass index** was low in the 1970s (<1,000 metric tons). It gradually increased to 7,900 metric tons in 1987, but has since declined to pre-1980 levels.



In the spring of 1995 schools of small pollock were observed by fishers, and fisheries personnel in many south coast harbors.

Ecological Factors

Pollock 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 and behaviour.

Outlook

Pollock have never been a major component of the commercial fishery in NAFO Subdivision 3Ps. Their contribution is based on the occurrence, and survival of year-classes against great odds in the extreme north of their range. Recent surveys show biomass and abundance are low for all sizes of pollock. However, in the spring of 1995, schools of small pollock have been observed in south coast harbors and this may be a positive sign.

For More Information

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

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DIVISIONS 2J3KL WITCH FLOUNDER

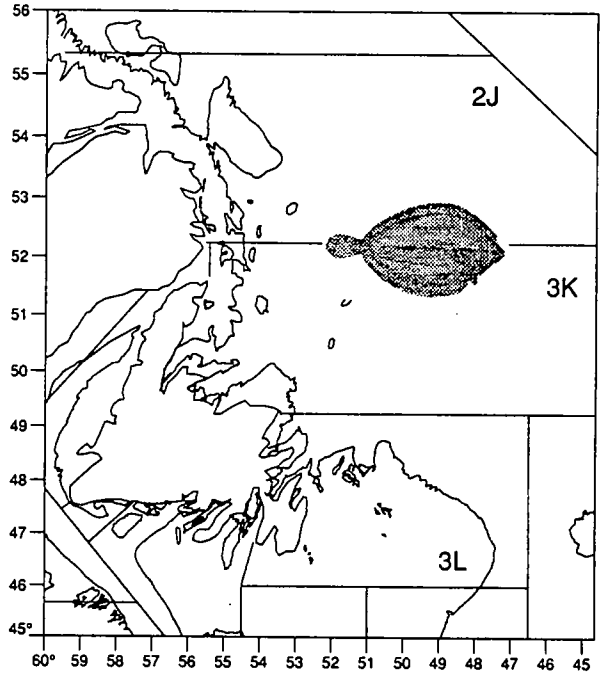
Background

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). It is 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 this area spawning takes place from March to July with highest intensity in the period March to May. During the winter and spring months it 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..



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. Catches in 1992 declined to 2,300 metric tons, the lowest since 1964, and further declined to 342 metric tons in 1993. A catch of only 12 metric tons was reported in 1994.

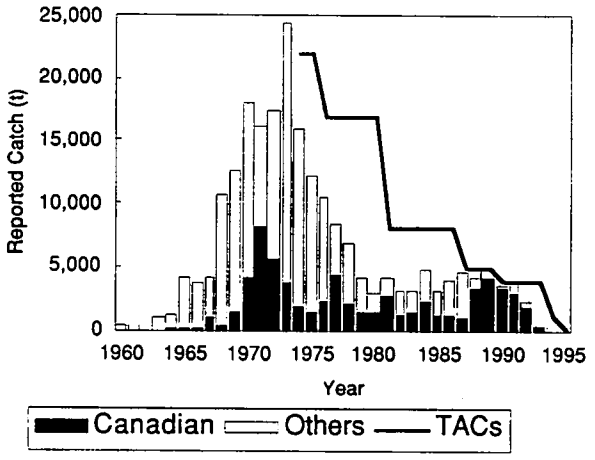
Landings (thousand metric tons)

Year	60-76 Avg.	77-90 Avg.	1991	1992[1]	1993[1]	1994[1]	1995
TAC	N/A	N/A	4	4	4	1	.1[2]
Can.	2	2	3	2	.3	+	
Others	7	2	1	.6	0	0	
Totals	9	4	4	3	.3	+	

[1] Provisional
[2] By catch only

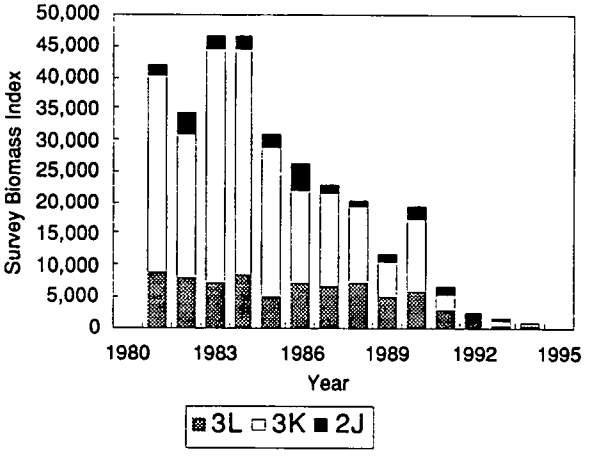
Up until the late 1980s the fishery was prosecuted by Poland, USSR and Canada primarily in Division 3K. In recent years, the fishery has been mainly Canadian although some

catches were estimated as taken by European Union (EU) (Portugal) in the NAFO Regulatory Area of Division 3L. For 1994, however, no catch of witch flounder was estimated for the Regulatory Area of Division 3L.



Resource Status

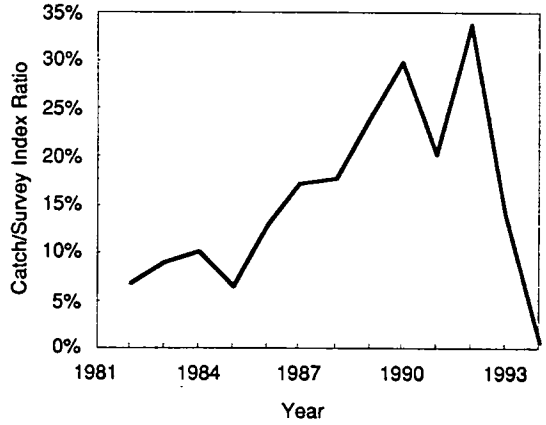
Research vessel surveys have been conducted in the fall in divisions 2J, 3K and 3L since 1977, 1978 and 1981 respectively.



For Division 2J, **biomass index** ranged from as high as 4,100 metric tons in 1986 to a low of less than 160 metric tons in 1994. In Division 3K, during 1979–85, there was a period of relative stability where most annual biomass index levels were over 30,000 metric tons. Since that time, they have declined considerably to just over 340 metric tons in 1994 the lowest in the time series. For Division 3L, the index biomass ranged generally between 6,000 and 7,000 metric tons from 1981–88 but declined rapidly since then to a low of just under 1,500 metric tons in 1992, and less than 400 metric tons by 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 estimate of 900 metric tons in 1994 the lowest in the time series compared to an annual average of over 40,000 metric tons during the early 1980s. In the earlier years, the biomass in all divisions was generally distributed in depths less than 500 meters. Since 1989 however, most witch flounder has been found in depths greater than 500 meters.

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.



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 indicate that this stock will increase in the foreseeable future. Any fishery in 1996 could be detrimental to stock rebuilding.

For More Information

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

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SUBDIVISION 3Ps
WITCH FLOUNDER

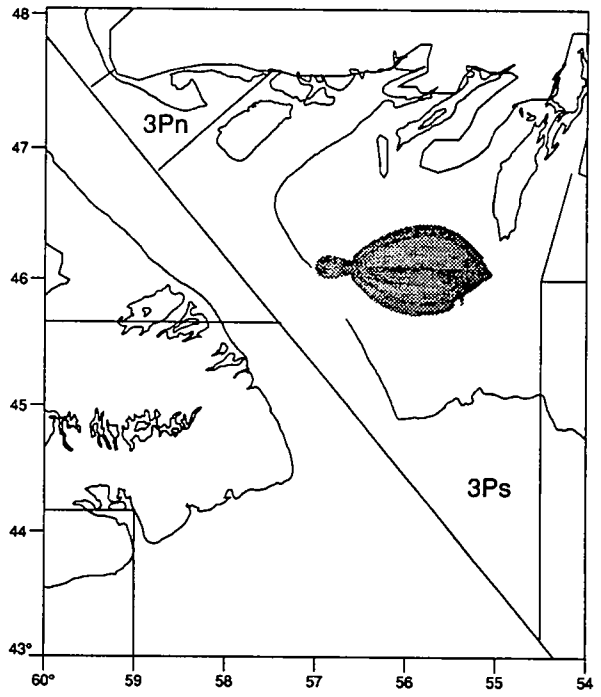
Background

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 m (109–219 fath.), more recently it has been caught mainly in depths well in excess of 900 m (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.

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 and it is here at this time when 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.



The Fishery

The catches of witch flounder in NAFO Subdivision 3Ps were about 1,000 metric tons annually during the 1960s. Catches 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 have 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 where the catch was only about 400 metric tons.

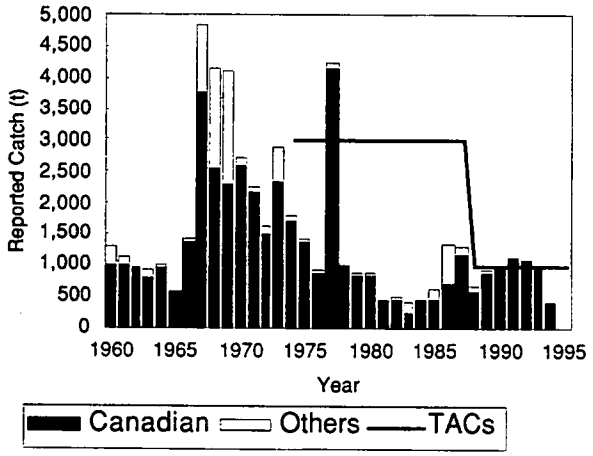
Landings (thousand metric tons)

Year	60-76 Avg.	77-90 Avg.	1991	1992[1]	1993[1]	1994[1]	1995
TAC	-	-	1	1	1	1	1
Can.	2	.9	1	1	1	.4	
Others	.4	.1	0	0	0	0	
Totals	2	1	1	1	1	.4	

[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 Scottish seiners and gillnetters fishing

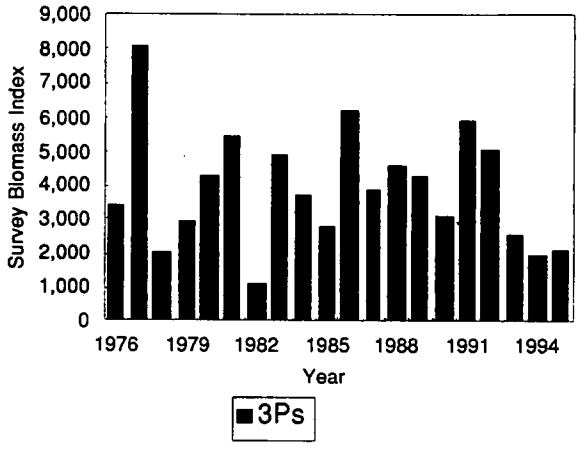
in Fortune Bay off the south coast of Newfoundland. Prior to the boundary settlement between Canada and France, fishers from St. Pierre and Miquelon also caught small amounts of witch flounder although this no longer appears to be the case.



The fishing pattern for offshore Canadian participants during 1994 appears to have been similar to that of 1993 according to information obtained from industry representatives. Fishing was conducted at the southeastern tip of St. Pierre Bank in depths ranging from 200 to 900 m (110 to 492 fathoms). As a result of the closure of the American plaice and cod fisheries in Subdivision 3Ps for 1994 combined with a 5% by–catch constraint, the fishery for witch flounder has been seriously hampered and resulted in the lower than usual catch level for 1994. The same by–catch level is in effect for 1995.

Resource Status

Stratified–random research vessel surveys have been conducted by Canada in wintertime 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 m (300 fathoms). The **survey biomass index** has been highly variable over the past 15 years fluctuating between 2,000 and 6,000 metric tons and showing little in the way of trends. An examination of the survey index by depth zone indicated that during the late 1970s and early 1980s there were considerable levels of the biomass in depths less than 183 m (100 fathoms) whereas during the 1990s there were none.



While survey results from 1993–95 are within the range of past biomass index estimates, good fishing occurred in deep water beyond the survey area in 1993 which would lend some support to the hypothesis that witch flounder are mostly distributed in depths not surveyed by the research vessels. On the other hand, the fishery concentrates within a relatively small area on a prespawning concentration of high density which may not be an indicator of a high level of biomass.

The research survey data do not indicate any increases in **recruitment** in recent years.

Outlook

Considering the stability in the survey biomass index of the last three years, and continued expectations of low commercial catch levels, it is anticipated that this stock should not decline under present conditions as a result of commercial fishing pressure. The recent biomass index points are at the low end of the long-term range.

When the TAC of 1,000 metric tons was initially advised, it was based upon an exploitation rate of about 25% (approximating

$F_{0.1}$) of the average index biomass estimate of about 4,000 metric tons during the preceding time period. The average index biomass estimate within the survey area during the 1993 to 1995 surveys is about 2,000 metric tons.

For More Information

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

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SUBAREA 2 + 3K REDFISH

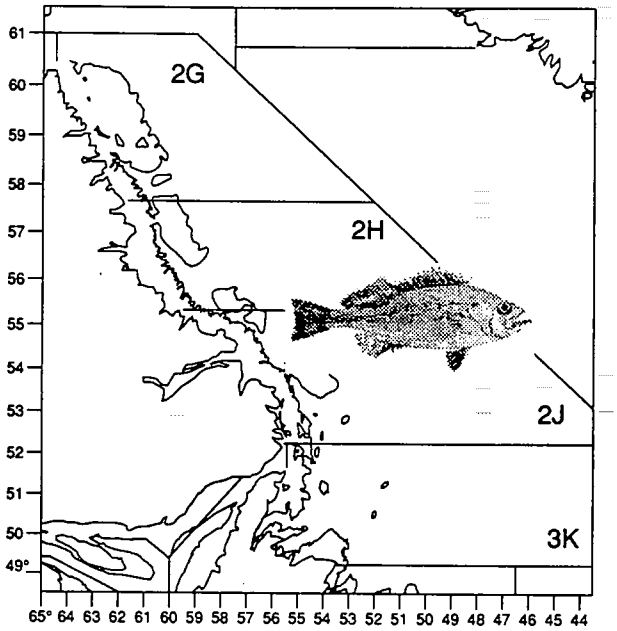
Background

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 waters (3° to 8° C) along the slopes of fishing banks and deep channels usually inhabiting waters from 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 in September to October and 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 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. Since 1986 catches declined from 18,500 metric tons to 280 metric tons by 1991 due primarily to a major redirection of effort to other redfish fisheries for the principal Canadian stakeholder. The fishery was predominantly by offshore otter trawlers and since 1979 primarily conducted in Division 3K.

The fishery has been under TAC regulation since 1974 when 30,000 metric tons 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, 200 metric tons has been set aside for test fisheries.



The Fishery

There has not been persistent directed effort on this stock since 1990 when 2,400 metric tons were landed. 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)

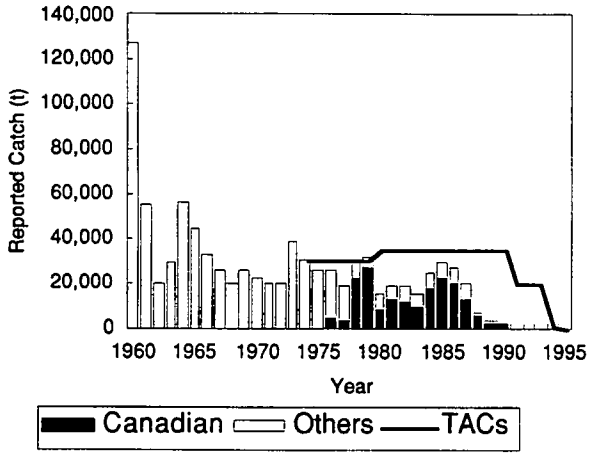
Year	60-76 Avg.	77-90 Avg.	1991	1992[1]	1993[1]	1994[1]	1995
TAC	N/A	N/A	20	20	20	1	.2
Can.	.3	12	.2	+	+	+	
Others	36	6	.1	+	+	+	
Totals	36	18	.3	+	+	+	

[1] Provisional

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

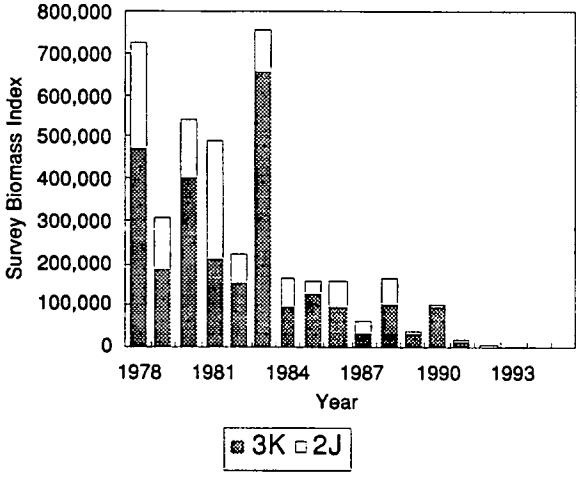
and no marks were encountered on the sounder while steaming.



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 of about 10 to 20 years. There has been very limited commercial fishery data available since 1991 when this fishery essentially became a by-catch fishery.

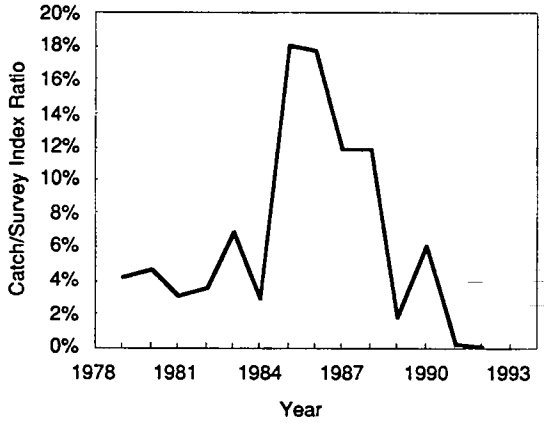
Results from research vessel surveys in divisions 2J and 3K suggest **population biomass indices** in both areas were at historically low levels in 1994.



Although there have been large fluctuations between some years in both divisions, there has been a general decline in the Division 2J biomass index from about an average of 200,000 metric tons (1978-1981) to an average of 1,600 metric tons (1992-1994). The Division 3K biomass index suggests an even larger reduction from an average of 316,000 metric tons (1978-1981) to an average of 1,000 metric tons (1992-1994).

There has been over 20 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 alone cannot account for the observed decline in the stock. Fishing does not appear to have been the most important factor, since a comparison of catches to survey biomass index suggests exploitation levels generally less than 5-6% during the 1980s, and never exceeded 20%.



Outlook

This stock is 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 has been nothing to indicate 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. Res. Doc. 95/25.

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DIVISION 3O REDFISH

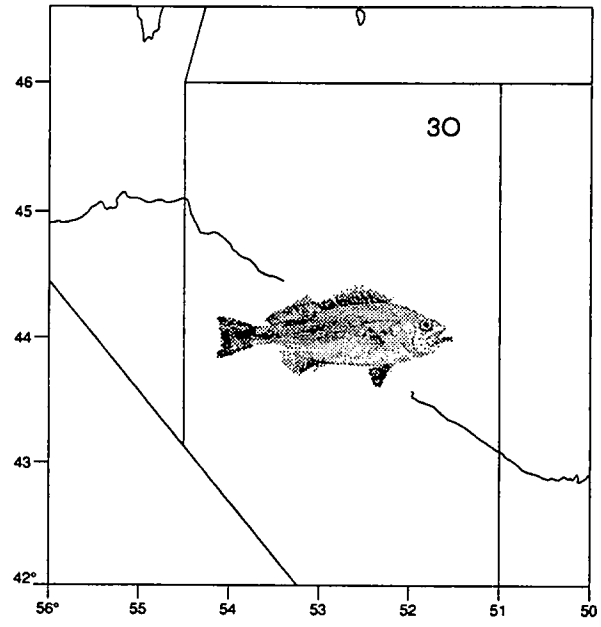
Background

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 waters (3° to 8° C) along the slopes of fishing banks and deep channels usually inhabiting waters from 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 in September to October and 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 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.

Traditionally, Canadian industry has not had a great deal of interest in redfish in this area because of the relatively small sizes of fish found in the areas with trawlable bottom. Recently, because of declines in other groundfish resources, and most recently because of developing markets for small redfish for lobster bait, there has been some increased interest in fishing in this area.

The first quota was put in place for Division 3O redfish in 1974 at 16,000 metric tons.



The Fishery

Since 1959 nominal catches have been in the range of 5,000 to 35,000 metric tons. Up to 1986 catches averaged 13,000 metric tons, increased to 27,000 metric tons in 1987 with a further increase to 35,000 metric tons in 1988. Catches declined to 13,000 in 1989 and have been about this amount through to 1992. The 1993 catch was estimated to be about 16,000 metric tons, but catches declined to only about 4,000 metric tons in 1994.

Landings (thousand metric tons)

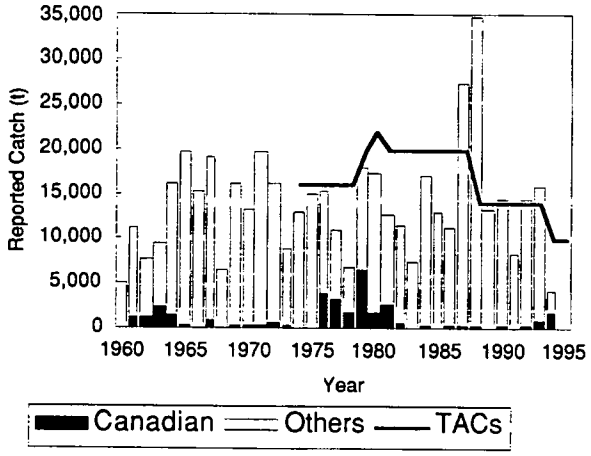
Year	70-76 Avg.	77-90 Avg.	1991	1992[1]	1993[1]	1994[1]	1995
TAC	-	-	14	14	14	10	10
Can.	1	1	+	.3	.7	2	
Others	13	14	8	14	15	2	
Totals	14	15	8	17	16	4	

[1] Provisional

Russia predominated in this fishery up until 1993 and generally took its share (about 50%) of the total non-Canadian allocation, which accounted for about 2/3 of the TAC.

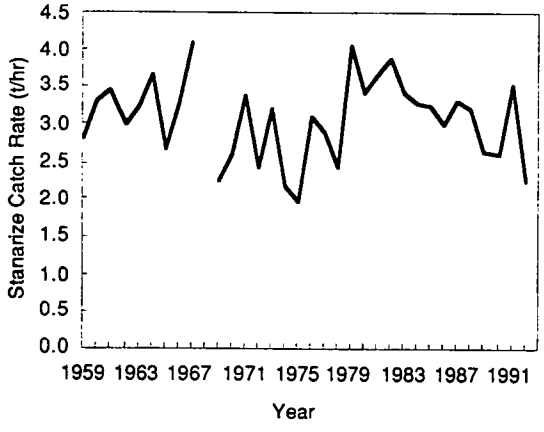
The fishery has occurred primarily in the second and third quarters of the year since 1983. The predominant means of capture from the mid-

1970s to the early 1980s was the bottom otter trawl, but since 1984 there has been an increase in the use of midwater trawls.

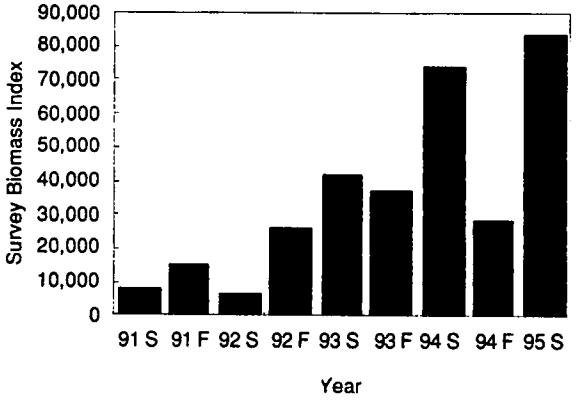


Resource Status

The standardized catch rate index based on effort in hours fished shows much interannual variability from 1959 to 1978. In 1979 there was a dramatic increase in the catch rate followed by a declining trend from 1979 to 1992. However, this trend may be more indicative of a decline in the proportion of the stock outside the 200 mile limit where most of the effort is concentrated.



Stratified random groundfish surveys have been conducted in the spring and fall in Division 3O since 1991, with coverage to depths of 730 m. From 1991 spring through 1992 spring the **survey biomass index** was about 10,000 metric tons. There was an increase in the index biomass to 26,000 metric tons in the fall of 1992, and a further increase in 1993 such that the average of the three surveys was 44,000 metric tons. The average of the spring and fall surveys in 1994 was about 50,000 metric tons. The spring, 1995 estimate was much higher at 84,000 metric tons. Caution is required in interpreting this however, as spring estimates were higher than those in the fall in 1992 and 1993. The reasons for this are not known. Stratum by stratum estimates indicate that the increases occurred over a great deal of the area.



A relatively low proportion of the estimates are accounted for by fish greater than 30 cm in any of the surveys since 1991.

Ecological Factors

With the loss of the 1988 year-class from Unit 1, questions have been raised about the possibility of the recent increases in Division 3O being the result of movement of this year-class from the Gulf to this area. Available evidence does not support this hypothesis, and recent increases in Division 3O may be partially associated with declines in Division 3N.

Preliminary analyses also suggest that growth rates and size of maturity, while similar in divisions 3N and 3O, are different from those further west.

Outlook

It is not possible to estimate the size of this stock. Consequently is not possible to determine fishing mortalities during the past nor the possible fishing mortality generated by catching the TAC of 10,000 metric tons in 1995.

Recently, more small redfish appear to be available in Division 3O based on research vessel surveys conducted during the 1990s. However, it is unclear whether redfish in this area are resident or migrants from another area. Based on the research vessel data, the stock appears to be mostly comprised of young immature fish, although significant amounts of larger fish have been found in the past in the deeper, hard-to-fish areas of the Division.

The length at which half the population is sexually mature (L50) is about 18 cm (7 inches) for males and about 28 cm (11 inches) length for females. Given that generally the shallower the depth fished the smaller the size composition, caution is warranted that a greater proportion of immature females may be captured if fishing is concentrated in shallower water (less than 375 m (205 fathoms)).

For More Information

Research Document: Shelton, P.A. and D.B. Atkinson (Editors). 1994. Proceedings of the Regional Groundfish Assessment Review for Newfoundland, May 9-13, 1994. Can. Tech. Rep. Fish. Aquat. Sci. 2020: 100 p.

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UNIT 2
REDFISH

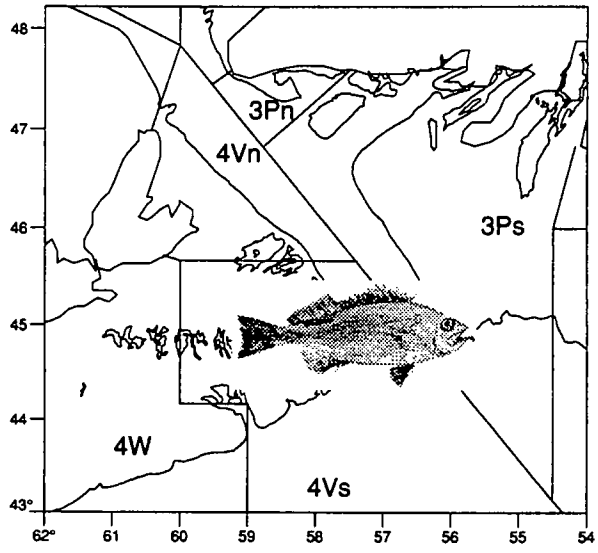
Background

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 waters (3° to 8° C) along the slopes of fishing banks and deep channels usually inhabiting waters from 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 in September to October and 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 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.

Unit 2 redfish represent a relatively new management unit. Redfish in this area (NAFO 3Ps4Vs, 3Pn4Vn-Jan. to June, 4W$_{fgi}$) were previously managed separately as a 3P stock and part of a 4VWX stock. In 1991, based on a detailed examination of available data, it was proposed to realign the management units to better represent what was known about the resource in these areas.

The new management units were put in place beginning in 1993. The quota for Unit 2 in that year was 28,000 metric tons.



The Fishery

Catches have ranged from 8,100 metric tons (1984) to 58,000 metric tons (1971). From 1960-1968 landings were at a level of 20,000 metric tons, increased to an average of 43,000 up to 1975 mainly due to increases by foreign fleets and subsequently declined to the lowest on record in 1984 at 8,100 metric tons. Catches then steadily increased to the 1993 value of about 27,000 metric tons.

Landings (thousand metric tons)

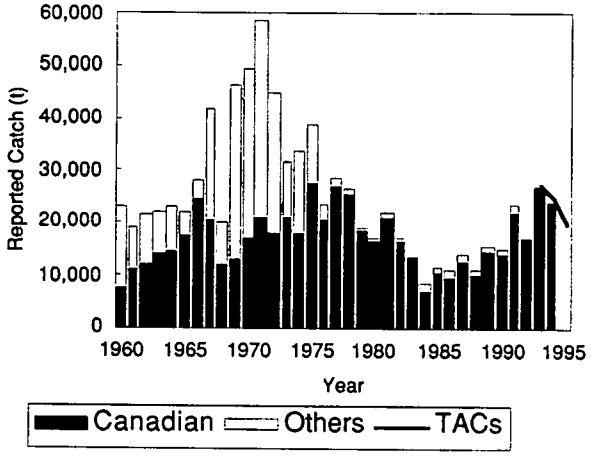
Year	70-76 Avg.	77-90 Avg.	1991	1992	1993	1994	1995
TAC	-	-	-	-	28	20	14
Can.	17	16	22	17	27	24	
Others	15	1	1	.2	0	0	
Totals	32	17	23	17	27	24	

[1] Provisional

Since declaration of the 200 mile limit in 1977, catches have been primarily by Canadian fleets. Maritimes vessels generally account for the majority of landings from subdivisions 4Vs and 4Vn while Newfoundland vessels concentrate in subdivisions 3Ps and 3Pn.

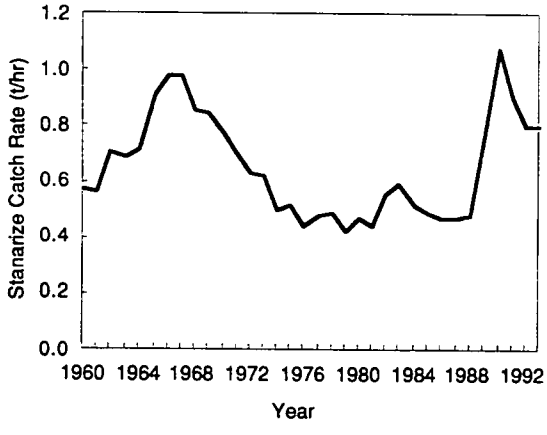
The 1993 fishery was quite different from that in 1992. There was a 10,000 metric tons increase from the 1992 catch of about 17,000 metric tons

and this was almost totally accounted for by landings from 3Pn during October to December. Based on information presented to the Fisheries Oceanography Committee in March, 1994 these catches were probably of Unit 1 redfish which moved into the area earlier in 1993. The situation reversed in 1994 when only about 1,200 metric tons were taken in subdivisions 3Pn4Vn during this period.



Resource Status

The **standardized catch rate series** based on hours fished shows a steady increase from 1960 to 1966 followed by a decrease to the lowest rate on record in 1979. The rate increased again until 1983 to about the same magnitude of the 1960 catch rate.

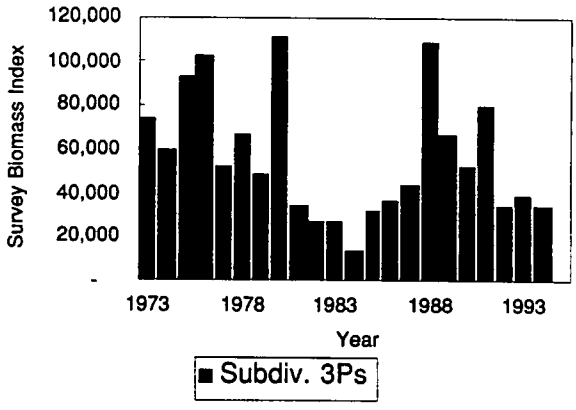


From 1983 to 1988 catch rates declined to about the level of the 1979 rate. Large increases occurred in 1989 and again in 1990 to the highest rate observed over the time series. The catch rate declined abruptly in 1991 and continued to decline in 1992. Preliminary data for 1993 (including only Nfld. fleet) suggest the mean catch rate remained at the 1992 level, but there is much higher variance associated with this estimate compared to any other year in the series.

The catch rates seem to track reasonably well with the movement of what were perceived to be strong year-classes (1956-58 and early 1970s) through the fishery.

Successive large increases in catch rates in 1989 and 1990 can be partly attributed to the recruitment to the fishery of the relatively strong year-classes of the early 1980s. However, it is also partly due a change from side trawlers to specialized stern trawlers for the FPI fleet and the utilization of the highly efficient midwater "turbo" trawl for all fleets. Midwater gears are aggregated in the current database utilized to derive a standardized catch rate series and therefore the historical relationships cannot be put into perspective.

Stratified-random groundfish surveys have been conducted since 1973 in Subdivision 3Ps generally in the February to April period.



It is important to note that these surveys do not cover the entire stock area so that apparent trends over time may not be reflective of

changes occurring throughout the entire management unit.

Length frequencies and numbers at age from the surveys reflect the **relatively strong year-class(es)** of the early 1980s that were first caught during the 1981 survey. These year-classes presently constitute the main component of the commercial fishery. There was also a much smaller pulse found first during the 1988 survey (perhaps the 1984-1985 year-classes), and a larger pulse observed in 1991 corresponding to the 1987-1988 year-classes. The 1984-1985 and 1987-1988 year-classes represented about 40% of the research catch in 1993. Because the surveys do not cover the entire stock area, it is not possible to estimate the abundance of these year-classes. However, it is quite evident that the early 1980s year-classes comprised a much greater proportion of the research catch than those of either 1984-85 or 1987-88.

A research survey was conducted in subdivisions 3Ps, 3Pn, 4Vs, and 4Vn during the summer of 1994. The **biomass index** (thousands of metric tons) from this survey was as follows:

	3Ps	3Pn	4Vs	4Vn
Index	105	18	37	79

It is not possible to compare these results with those from the Subdivision 3Ps survey series because a different net was used. Another survey will be conducted during the summer of 1995.

Outlook

Because of the limited database, it is not possible to provide an estimate of the size of this stock, and therefore it is not possible to estimate fishing mortalities during the past nor the possible fishing mortality generated by catching the TAC of 14,000 metric tons in 1995.

This stock is probably lower than it has been in recent years. Fishing pattern has changed in response to the implementation of this new management unit in 1993.

The fishery is currently targeting the relatively good year-classes of the early 1980s. Above average recruitment to the fishery is expected within the next few years based on the relatively strong year-classes of the mid-1980s but their contribution is likely to be less than that of those of the early 1980s.

Other

A special multi-disciplinary project has been established to study redfish. The aim is to carry out this work in partnership with industry, and an initial industry/DFO meeting was held on June 1-2 to begin the process. Further information on this initiative will become available later in the year.

As noted above, another survey will be conducted in all of divisions 3P and 4V. An updates Stock Status Report which includes the results of this survey will be available in September.

For More Information

Research Document: Shelton, P.A. and D.B. Atkinson (Editors). 1994. Proceedings of the Regional Groundfish Assessment Review for Newfoundland, May 9-13, 1994. Can. Tech. Rep. Fish. Aquat. Sci. 2020: 100 p.

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LUMPFISH IN DIVISIONS 3K, 3L AND 3P

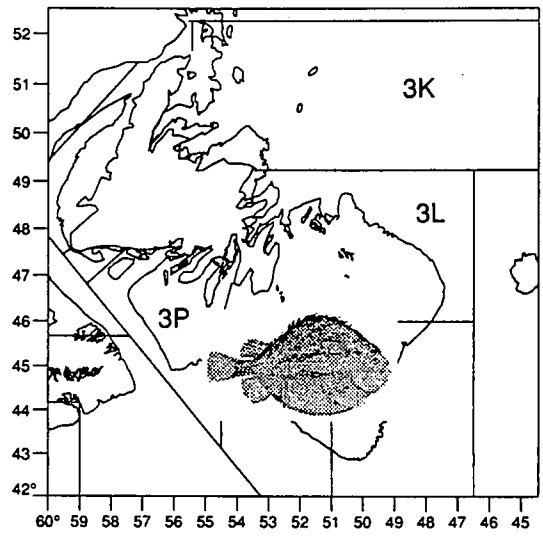
Background

Lumpfish 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, and other marine mammals. 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.



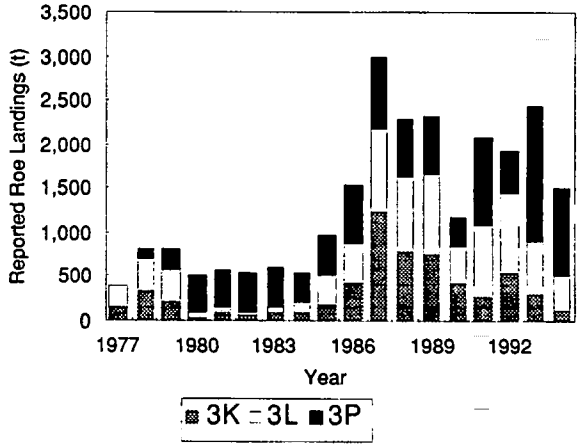
The Fishery

The commercial fishery began for lumpfish roe in Newfoundland in 1976 with catches around 500 metric tons up to 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 for the next 6 years. There was a 25% decline between 1993 and 1994 to 1,500 metric tons of roe.

Roe Landings (thousand metric tons)

Year	77-90 Avg.	1991	1992[1]	1993[1]	1994[1]	1995
Can.[2]	1	2	2	2	2	

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



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 divisions 3KLPs by 1994.

Resource Status

The stock structure of this species is not known and little work has been done in this area. Research survey **indices of biomass** have been calculated separately for NAFO divisions 3K and 3L for 1981-1994 and 1981-1995 for Subdivision 3Ps. Fall survey estimates have been generally less than 2,000 metric tons in divisions 3K and 3L. In Subdivision 3Ps, the surveys occurred from January to June and biomass estimates have declined an order of magnitude from 1985 to 1995. Also the proportion of survey catch that is females has declined steadily over the same period.

Initial catch-effort data analysis from 2 index fishers in Division 3K have indicated a steady decline over the past four years as have the total landings for this division. This decline in catch rate is not as evident in Subdivision 3Ps but 1994 estimates are the lowest of the last four years although total landings remained relatively high.

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 possibly catch-rates. In Subdivision 3Ps, survey indices have gone down since the mid-1980s and the proportion of females has declined.

Conservation methods could be implemented, such as closure of portions of the spawning areas in the major bays or development and adoption of roe stripping techniques resulting in lower mortality.

For More Information

Research Document: Hoenig, J.M. 1995. What can we learn about lumpfish mortality from sex ration 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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DIVISIONS 3LNOPs 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 is the smooth skate (Raja senta). 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. It is found in depths ranging from about 18 m (10 fathoms) to over 1000 m (550 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. Generally they move less than 100 km during their lives.

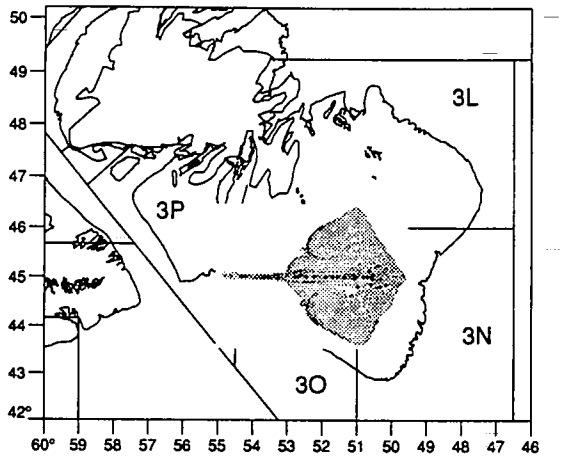
It is not known how long thorny skate live in the waters around Newfoundland. Based on the time between tagging and recapture of some individuals, it is known that they can live at least 20 years. They deposit egg cases, perhaps better known as mermaids' or sailors' purses, inside of which are single 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 is very little information on predators of skate around Newfoundland. They have been found in the stomachs of seals, sharks and Atlantic halibut.

Historically, there has been only limited interest in fishing for skate in the waters around Newfoundland. Most of the reported catches have been by non-Canadian fleets; Canadian catches have traditionally been incidental to catches of other groundfish species, and skates were usually discarded. With the decline of other groundfish resources, Canadian interest in skates has increased, and quotas were first put in place for 1995 inside Canada's 200 mile limit.

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).



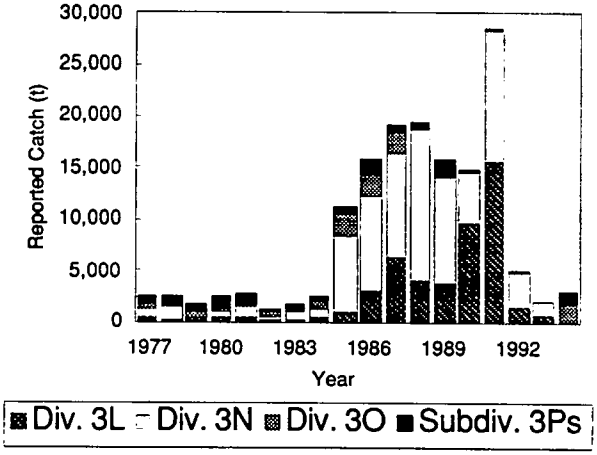
The Fishery

Because of almost no interest in a skate fishery 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.	85-90 Avg.	1991	1992[1]	1993[1]	1994[1]	1995[2]
TAC							6
Cdn.	.7	.1	+	.1	+	3[2]	
Others	2	16	28	5	2		
Totals	3	16	28	5	2	3[2]	

[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, Canadian surveillance estimated catches outside 200 miles to be higher than those reported.

It must be remembered that in addition to the reported catches, there have been ongoing discards in other groundfish fisheries. To date, the levels of these discards have not been estimated.

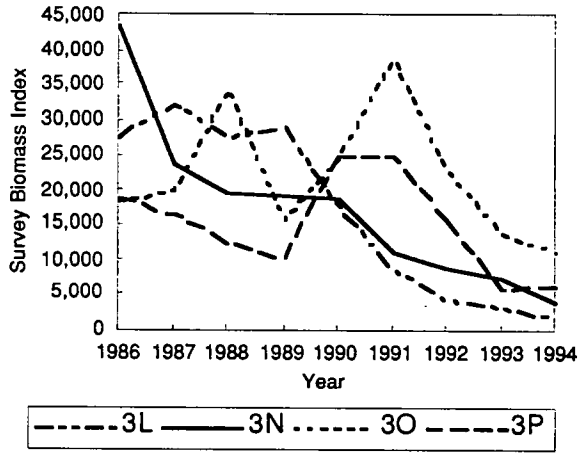
Because of the declines in other, more 'traditional' groundfish resources along with the development of markets in Europe for skate wings, fishers in Newfoundland became interested in skates, and successful test fisheries were first carried out in 1994. There was concern about by-catches of other species such as cod, but selection studies were done, and with the use of 305 mm (12 inch) mesh otter trawl catches had almost no by-catch. The same was the case for gillnets using 267 mm (10.5 inch) mesh. By-catch problems were found however, when using longlines and the use of this gear is still under investigation.

During the fall of 1994, all indications were that there would be interest in an expanded fishery in 1995, and some advocated that similar to the fishery for skate outside 200 miles, the fishery inside should be unregulated. Managers however, were concerned that such an uncontrolled fishery might deplete the resource, so quotas were put in place for 1995.

At the time, only limited information was available upon which to base quotas. The area of interest covered two banks; the Grand Banks and St. Pierre Bank. It was decided to split the quotas between these two areas. Some information on stock size was available from research surveys to the two areas, and the quotas were set based on a **20% exploitation rate of the survey biomass indices** averaged from 1991 to 1993. This resulted in 1995 quotas of 5,000 metric tons for the Grand Banks (3LNO), and 1,000 metric tons for St. Pierre Bank (3Ps).

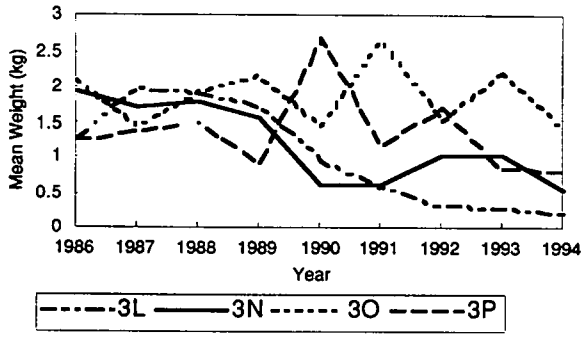
Resource Status

Some further preliminary examinations of the research data have been carried out. **Research survey indices of biomass** have been calculated separately for NAFO divisions 3L, 3N, 3O and 3P for the period 1986 to 1994.

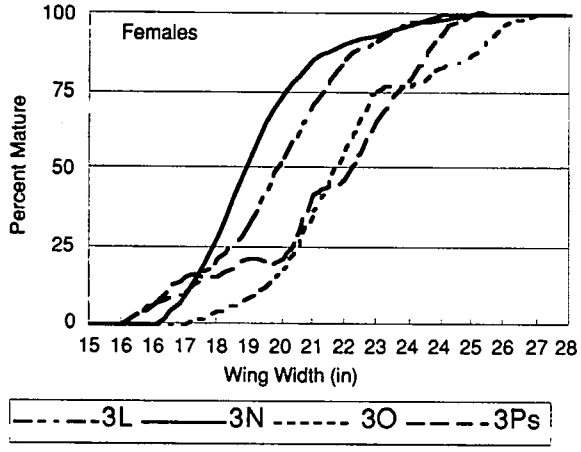


The results indicate that the **biomass** of thorny skate in Division 3O and Subdivision 3Ps remained relatively stable until the early 1990s, but has declined recently, particularly in Subdivision 3Ps and in 1994 was at the lowest level in the time series. The biomass declined steadily in divisions 3L and 3N over the 1986 to 1994 time period, possibly as a result of the high catches outside 200 miles during the second half of the 1980s.

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. There have also been recent declines in Subdivision 3Ps.



Some **maturity information** based on sampling carried out from 1947 to 1972 is available from the 3LNOPs area for female thorny skate.



Based on this information, 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. About 50% are mature when the wing width is 56 cm. (22 inches).

Outlook

It appears that the high catches (including unestimated discards) of skate, particularly outside 200 miles during the second half of the 1980s, may have resulted in a decline of the resource in divisions 3LN. At the present time, the catches of skates outside 200 miles are completely unregulated.

Lower catches, both reported plus discards (unestimated), do not seem to have affected the resource in 3O and 3Ps to the same extent during the same period, although the reasons for the recent declines in these latter two areas, particularly Subdivision 3Ps, are unclear at present.

There are indications that catch information from the area outside 200 miles is unreliable, and discarding inside 200 miles has not yet been quantified.

Preliminary analysis of research data indicates 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 may be prudent to consider managing divisions 3LN as one area, and Division 3O as another. Based on recent trends in the biomass index, Subdivision 3Ps should possibly be managed as yet another. This requires further close examination.

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 steps be taken to ensure that effort is not concentrated in any one area, but is spread out amongst different concentrations. This will better ensure sustainability of the resource.

For More Information

Research Document: Atkinson, D.B. 1995. Skates in NAFO divisions 3LNO and Subdivision 3Ps: A Preliminary Examination. DFO Atl. Res. Doc. 95/26.

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