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Report on the Assessments of Groundfish Stocks in the Canadian Northwest Atlantic May 4-14, 1993

Editor

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Alan Sinclair Gulf Fisheries Centre Department of Fisheries and Oceans P.O. Box 5030 Moncton, N.B. E1C 9B6 Minister of Supply and Services Canada 1993 Cat. No. Fs 97-6/1946e ISSN 0706-6457

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## Report on the Assessments of Groundfish Stocks in the Canadian Northwest Atlantic May 4-14, 1993

## Table of Contents

Abstract/Resume				
1. 2.	Introduction			
	2.1. 2.2.	Catch and Effort Statistics 1   Identification of Flatfish Species 2		
3.	Defin	ition of Conservation for Groundfish Stocks		
	3.1. 3.2 3.3.	Overview 3   Biological Reference Points 4   Definition of Conservation 4		
4.	Implications of Moving to F <sub>0.1</sub>			
	4.1 4.2.	Reduction of Fishing Effort 5   The Need for a Long-term Plan 6		
5. 6.	On Avoiding the Capture of Small Fish			
7.	Trends in Abundance of Other Living Marine Resources			
	7.1 7.2. 7.3.	Introduction		
	7.4.	Biomass Trends in the Scotia-Fundy Groundfish Surveys		
8.	Over	view of Groundfish Stocks 14		
	8.1. 8.2.	General Overview of Commercially Exploited Groundfish		
	8.3.	Newfoundland Shelf and on the Grand Banks		
×	8.4.	Gulf of St. Lawrence 18   Overview of Commercially Exploited Groundfish on the 19   Scotian Shelf and on Georges Bank 19		
9.	Stock Status Summary Sheets 22			
10	Stock	Assessments 54		

	10.1. 0 10.2. 0 10.3. 0 10.4. 0 10.5. 0 10.6. 0 10.7. 0 10.8. H 10.9. H 10.9. H 10.10.	Cod in Divisions 2J+3KL 54   Cod in Subdivision 3Ps 59   Cod in Divisions 3Pn,4RS 61   Cod in 4T-Vn (JA.) 66   Cod in Division 4VsW 72   Cod in 4X 79   Georges Bank Cod in Unit Areas 5Zj,m 83   Haddock in Divisions 4TVW 86   Haddock in Division 4X 90   Haddock in 5Zjm 95   Pollock in 4VWX+5Zc 98
	10.12. 10.13. 10.14. 10.15. 10.16. 10.17. 10.18. 10.19. 10.20. 10.21. 10.22. 10.23. 10.24. 10.25. 10.26. 10.27.	(4RST, 3Pn (JanMay) and 4Vn (JanMay)101American Plaice in Subarea 2+ Division 3K103American Plaice in Subdivision 3Ps104American Plaice in Division 4T106American Plaice in Division 4VW107American Plaice in Division 4X108Witch Flounder in Divisions 2J3KL108Witch Flounder in Subdivision 3Ps110Witch Flounder in Divisions 4R and 4S111Witch Flounder in Divisions 4R and 4S111Witch Flounder in Divisions 4R and 4S113Yellowtail Flounder in Division 4X113Yellowtail Flounder in Division 4X114Halibut in Divisions 4VWX and 3NOPs115Atlantic Halibut in Divisions 4RST117Greenland Halibut in 4RST117
11. 12. 13.	Timing By-cate Other E 13.1. 13.2. 13.2. 13.3. 13.4. 13.5.	of the Winter Migration of 4T Cod into 4Vn119ch of Finfish in the Northern Shrimp Fisheries120Business121Comparative Visual and Histological Observations121Nonparative Visual and Histological Observations121Nonparametric Stock-recruit Analysis and122Replacement Recruitment122The Estimation of Ageing Error Probabilities123Can We Estimate F From Length Frequency Data?123
14. 15. 16. 17. 18. 19. 20.	Acknow Referen Figures Annex Annex Annex	vledgements 124   nces 125   1. Participants 127   1. Participants 186   2. Abbreviations 187   3. Working Papers 188   4. Additional information on Georges Bank cod and haddock 192

19. 20.

iv

### Report on the Assessments of Groundfish Stocks in the Canadian Northwest Atlantic May 4-14, 1993

#### Abstract

Sinclair, A. (Editor). 1993. Report on the assessments of groundfish stocks in the Canadian northwest Atlantic, May 4-14, 1993. Can. Tech. Rep. Fish. Aquat. Sci. 1946e.

Stock assessment scientists from the Canadian Department of Fisheries and Oceans met from May 4-14, 1993 in St. John's, Newfoundland to review stock assessments of groundfish stocks within the Canadian northwest Atlantic. This report presents the proceedings of this meeting and has two main purposes. Firstly, it provides the scientific basis for a report on stock status which was presented to the newly formed Fisheries Resource Conservation Council. Secondly, it provides a record of the technical discussions at the meeting, the main issues faced, decisions taken, and research recommendations for future work.

#### Résumé

Sinclair, A. (Rédacteur). 1993. Rapport sur l'évaluation des stocks de poisson de fond des eaux canadiennes de l'Atlantique nord-ouest du 4 au 14 mai 1993. Rapp. tech. can. sci. halieut. aquat. 1946f.

Les scientifiques responsables de l'évaluation des stocks au ministère des Pêches et des Océans du Canada se sont réunis du 4 au 14 mai 1993, à St. John's (Terre-Neuve), pour examiner les évaluations des stocks de poisson de fond dans les eaux canadiennes de l'Atlantique nord-ouest. Le présent rapport, qui rend compte de cette réunion, visait deux grands objectifs. D'une part, fournir les bases scientifiques nécessaires à un rapport sur l'état des stocks, qui a été présenté au tout nouveau Conseil pour la conservation des ressources halieutiques. D'autre part, relater les discussions techniques tenues et les principaux sujets traités à cette réunion, ainsi que les décisions et les recommandations de travaux scientifiques futurs qui en sont issues.

### 10.1. Cod in Divisions 2J + 3KL (WP 120, 122) C. Bishop, C. Taggart

10.1.1. Introduction

Landings from 1959 to 1992 have ranged from a high of 810,000t (1968) to a low of 44,000t in 1992 (Fig.10.1a,b)

In June 1991, CAFSAC commented on the appropriateness of the 185,000t TAC as incorporated in the longterm management plan. It was concluded that this would allow stock size to increase. The poor commercial fishery of 1991 and much lower than expected research survey results in the autumn of 1991 led to a reassessment of stock status. A preliminary assessment in January 1992 recommended limiting the catch in the first half of 1992 to half that taken in the first half of 1991; that is, in the order of 25,000t. The TAC was reduced to 120,000t in February.

In July 1992, CAFSAC advised that the 2J3KL stock was at an extremely low level; the 3+ biomass and the 7+ biomass (the latter approximating the spawning stock biomass) estimates were at or near the lowest levels ever observed. The fishery was expected to be dependent on the 1986 and 1987 year-classes with the 1988 year-class being below normal and approximating the low 1983 and 1984 year-classes. Analysis indicated a 1992 F<sub>0.1</sub> catch of between 50,000t and 79,000t. Reported and projected catches by mid-year would account for approximately 35,000t. CAFSAC recommended that the catch in 1992 be restricted to the lowest possible level. Similar advice was provided after the June 1992 Scientific Council meeting of NAFO. The Canadian offshore fishery was closed in May 1992, and subsequently the entire commercial cod fishery in 2J3KL was closed with the announcement of the cod moratorium in July 1992.

#### 10.1.2 Data

#### Catch and average weight at age

Sampling data were available only for the Canadian commercial catches and these were used to obtain estimates of catch and average weights at age for the total catch in 1992. Ages 5 and 6 (the 1987 and 1986 year-classes) were most abundant by number in the commercial catch as was the case in 1991. Average weight at age 7 in 1992 was the second lowest since 1977 (Fig.10.1c).

#### Research vessel survey data

Research vessel surveys have been conducted by Canada during the autumn in divisions 2J, 3K, and 3L beginning in 1977, 1978, and 1981 respectively. Biomass and abundance estimates have indicated a declining trend since 1988, especially in Divs. 2J and 3K (Figs 10.1d,e,f). The 1992 estimates for all 3 divisions were the lowest in the time series.

In the autumn 1992 survey, over 80% of the estimated biomass was located in Div. 3L, and survey catch rates indicated the greatest concentrations of cod in the deeper strata near the shelf break (Fig.10.1g). The 1987 year-class was most abundant in divisions 2J and 3K while in Div. 3L the 1987 and 1988 year-classes dominated. No cod older than age 7 were collected in Division 2J. The autumn survey results indicate that there has been no improvement in recruitment prospects.

Survey time in 1992 was allotted for limited coverage (using the bridge sounder to detect fish, and trawling where possible) of the nearshore areas which are not normally included in the regular survey. Very few cod were encountered in the inshore areas surveyed.

#### Additional surveys

Winter (February) hydroacoustic surveys offshore in 1991 to 1993 indicate substantial declines in average density, particularly in 1993. The only significant concentrations were located outside the normal survey area in waters 930m deep where the foreign fleet was fishing. The January 1993 offshore tagging initiative was unable to locate any suitable cod concentrations along the entire shelf break from Hamilton Bank (2J) to the Nose of the Bank (3L) at depths ranging from 150m to 600m.

#### 10.1.3. Estimation of Stock Parameters

An illustrative sequential population analysis (SPA) suggested that total mortalities were high, as was the case last year. Presently, there is not sufficient information to partition total mortality into fishing and natural components. It would therefore be misleading to present the results either assuming a constant natural mortality (M) of 0.2 or with an arbitrarily increased M in 1991 and 1992. There are no doubts, however, that biomass is extremely low. Based on the 1992 survey, the total biomass could be as low as 100,000-150,000t.

#### 10.1.4. Discussion

Possible factors effecting the abundance of cod are fishing, biological interactions, and environmental conditions.

#### The fishery in 1992

The total estimated cod catch for 2J3KL in 1992 was approximately 44,000t. The reported Canadian commercial catch was 23,796t, a commercial catch of 583t was reported by France; the offshore foreign catch (outside 200 mile-limit on the Nose of the Grand Bank) was estimated by Surveillance Branch at 14,300t (10,750t of which comes from the European Economic Community (EEC); the EEC has reported 9,532t to NAFO as of the end of November 1992), and 5,000t estimated from the inshore "recreational fishery". The latter estimate is based on a combination of information supplied by DFO and the United Fish, Food, and Allied Workers Union.

No commercial catch was reported from Div. 2J. Almost all (95%) of the Canadian catch was taken in Div. 3L over the period of January to May 1992. Approximately 30% of the total Canadian catch was taken by the recreational fishery using jiggers or baited hooks. The Canadian offshore otter trawl fishery was typified by low catch rates and catches of small fish.

A continuing fishery may retard the recovery. It was noted that the survey abundance estimates showed a greater decline in 2J and 3K while most of the fishery occurred in 3L. The autumn surveys were conducted in the offshore areas and do not provide the status of potential inshore stocks. The impact of recreational fisheries on these stocks is not known.

#### Biological and environmental considerations

The following biological and environmental information is drawn from a meeting of Fisheries Oceanography Subcommittee (March 1993), and the Northern Cod Hypotheses Workshop (Jan. 1993) and are presented as important ancillary information to be considered in assessing the status of the 2J3KL cod stock(s).

#### **Biological considerations**

There are indications from trawl and acoustic surveys, and from the commercial fisheries that the recent decline in stock biomass was abrupt and occurred between January and June 1992. Other interpretations of the data suggested a more gradual decline that began first in the north (2J) in 1990 and propagated southward. The survey shows that changes in distribution were taking place prior to 1991 (Fig.10.1g) and the biomass of other commercial and non-commercial demersal species declined gradually during the 1980s (Fig.10.1h).

There is a significant non-linear relationship between area occupied and biomass for most species, in each division. This relationship has important assessment consequences as catchability will increase with

decreasing stock distribution, causing increased fishing mortality per unit effort. This may have happened with northern cod as the autumn 1992 survey showed a concentration of cod in the deeper portion of Div. 3L near the shelf break (Fig. 10.1g)

Declines were also observed in capelin biomass during the 1990s. Offshore acoustic surveys consistently failed to detect large concentrations beginning in the autumn of 1990, although information from inshore indices suggests that biomass has remained normal or above normal for the period. If capelin biomass has not declined, then results from recent acoustic surveys would suggest distribution or behaviourial changes.

The condition of cod according to body and liver indices in 1977-92 both indicate declining trends in 2J and 3K from 1989 onward with the decline being most pronounced in 2J. Cod feeding data from 1978 and 1980-91 indicate that stomach fullness indices in 1991, when capelin abundance was relatively low, were not substantially lower than in 1978, 1980 and 1982.

There is considerable interannual variation in size and age of maturity, but cod were mature at a considerably smaller size in 1992. In all three divisions females mature at a later age and larger size than males. Older female cod begin annual maturation later than younger females and males are in spawning condition for a longer period than females. The reduction in the proportion of older individuals will likely reduce the duration of spawning. This may have two consequences: increased recruitment variability, and reduced probability of good recruitment. It was also determined that the number of recruits required to maintain the spawner biomass has increased steadily since 1980 as a consequence of reduced weights at age (see Section 13.3).

Inshore spawning may have provided a considerably larger contribution to recruitment in coastal regions than previously thought. Published information on spawning distributions has shown that spawning occurs on the outer edges of the offshore banks (Fitzpatrick and Miller 1989). This had been interpreted as representing the main spawning component of the stock. However, analysis of data from 1946 to 1992 indicated that spawning can occur across the entire 2J3KL shelf to within 10 km of the coast in eastern Newfoundland and southeastern Labrador.

Inshore trap landings in Bonavista and Trinity bays generally start one month earlier in the inner reaches of the bays relative to the outer reaches suggesting the earlier landings may be derived from cod overwintering in the nearshore and later landings derived from offshore-to-inshore migrants. The regional timing pattern of inshore landings varies among years (relatively high landings in the north and west while poor in the south and east and vice-versa). The pivot for oscillations appears to be in the area of Baie Verte Peninsula.

Juvenile survey data from 1992 indicate that 0-group cod were restricted to the inshore bays. One and two year-old cod occurred on the shelf but were most abundant within the inshore bays. By age 3+, cod were distributed more abundantly over the shelf and at the shelf edge, although the highest catch occurred inshore. These results indicate that inshore abundance of juvenile cod was high relative to that offshore. There were few juvenile cod observed offshore in 1992, when compared with the historical distributions of young cod in the autumn research vessel surveys (1981-82) and to pelagic 0-group cod surveyed in 1981.

#### Environmental considerations

Near record low air temperatures persisted throughout 1992 in coastal regions bordering the Labrador Sea. Cold air and strong northwesterly winds during winter resulted in earlier ice formation, greater extent and later retreat than normal.

Station-27 water temperatures for 1992 were generally below normal throughout the water column. Nearbottom temperatures were slightly warmer than in 1991 but continue the pattern of below normal values as observed since 1983. Station-27 salinities were below normal through most of 1992. The summer areal extent of the cold intermediate layer decreased relative to 1991 but was still larger than normal. The generally cold conditions observed during the 1990s are similar to those observed in the early 1970s and mid-1980s. Surface temperatures over the 2J3KL survey area were 1.0 to 2.0 degrees below the long-term average during November 1992 and 1.0 to 3.0 degrees below the 1991 values for the same period. Bottom temperatures over the 2J3KL survey area in the autumn 1992 were as much as 1.0 degree below the 1980-1990 average. Negative bottom temperature anomalies were mainly restricted to Div. 3L in 1991, but were distributed throughout 2J3KL in 1992. Oxygen levels in June 1992 at depths greater than 200m over a large part of the shelf in the Cape Bonavista area were below 75% saturation. Cod are believed to become stressed when the water is below 60% oxygen saturation. Oxygen minima were associated with salinities of 34.25-34.50 psu and located in the "cod migration corridor". No data are available for previous years.

The North Atlantic oscillation (barometric pressure difference between Azores and Iceland) has shown a positive (cold winters) trend over the last several years and the continuing poor growth and recruitment in northern cod may be associated with this trend. Predictions of recent recruitment are not high, based on a combination of spawning biomass and salinity-based models.

#### 10.1.5. Prognosis

Although a moratorium was in effect during the last half of 1992, it is estimated that about 5,000t or more were taken by the "recreational" fishery. Research vessel survey biomass and abundance estimates in 1992 were the lowest observed in the time series.

Data from a 1993 winter hydroacoustic survey indicate very low densities with cod being most abundant at depths in excess of 900m in the area of the Nose of the Bank. The foreign fleet was also observed fishing in the same area. Surveillance Branch has verified that there was cod directed effort in this area in 1993 and that the catch may have been in the order of 3,000-4,000t.

Any recovery in 2J3KL cod depends on the appearance and survival of strong year-classes like those seen in 1986 and 1987. The population appears to have continued to decline in 1992, even in areas in which no fishing occurred. The recreational fishery is likely to be harvesting inshore populations which may be important for stock rebuilding. Growth of the offshore populations may be compromised by harvesting in offshore areas.

The significance of predation by harp seals must be viewed in the context that only 2 of 122 harp seals captured away from areas of offshore commercial fishing contained significant amounts of cod in their stomachs, while seals near fishing vessels had eaten cod predominantly less than 41cm, some of which may have been discards. Investigations of seal diets that take into account the distribution of seals throughout the year are being developed to estimate actual volumes of dietary items.

The decline in the 2J3KL stock appears to be continuing even in areas where there was no fishing in 1992. The 1992 research vessel biomass index decreased by 70%. There are a number of environmental, biological and fishery related factors that have, and are likely to continue to contribute to declines. Any recovery will depend on the appearance of and survival of strong year-classes. The 1986 and 1987 year-classes which had previously been estimated as above average have decreased substantially in abundance and they are now below average. The 1988-1991 year-classes are all expected to be below average in abundance. Recovery of the spawning stock biomass is unlikely for several years.

Cod in 2J-3KL

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Fig. 10.1a.

Total catches (t) and TACs (t)















RV Biomass - 2J (t)







RV Biomass - 3K (t)







Abundance Indices



Figure 10.1g. Cod Distribution 1989-1992 from Autumn 2J3KL RV Surveys, Numbers per Tow.





