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Northwest Atlantic Fisheries Organization

Serial No. N2361 NAFO SCR Doc. 94/5

SCIENTIFIC COUNCIL MEETING - JUNE 1994

On the Problem of the Commercial Fish Populations Abundance Control in the Northwest Atlantic Since 200-miles Economic Zones Enforcement

by

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Abstract

The attempt to reveal major trends in abundance regulation (fishery management) of stock units, classified according to the geographical pattern, taking in account the 200-mile economic zone, have been made based on the study of all commercial species, except invertebrates in NAFO Subareas 2-4 in 1977-92. The following population groups are identified:

1. Those distributed in the northern edge of species area and 200-mile zone.

2. Those distributed in the middle part of species area and 200-mile zone.

3. Those partially or entirely distributed in NAFO Regulatory Area.

For the first group of populations, the abundance of which seems to be controlled mainly by oceanographic factors, it is concluded that with persistent unfavourable conditions for young fish survival, even the total fishery prohibition will provide no positive effect. However, the first strong year-class after the depression period should be protected by all means against premature capture, when the latter is suspected. The stock state dynamics of the second population group in 1977-1992 shows that maintenance of the optimum fishery mortality level for some populations is the main method of abundance regulation. Besides, a possible environmental effect upon the young fish survival and adult fish distribution should be considered. As to the third group, the great danger of overfishing requires a strict control over fishery regulations observation, and the optimum fishing mortality level maintenance are necessary conditions of successful control of that group's abundance. The environmental factor effect should be considered as well.

Introduction

The extension of Coastal States jurisdiction to a 200-mile zone creates an unusual situation for stock units, fished in NAFO Subareas 2, 3 and 4 from the fishery management point of view. Essential parts of the latter have come under Canadian jurisdiction, while the area of the others appeared at both sides of the zone's border, and only a few species distributed entirely in the NAFO Regulatory Area. Thus since the beginning of a new era in the Coastal States fishery, terms of fish stock management were different in various parts of the Northwest Atlantic Ocean. While those differences affect greatly the species abundance variability, it is rather difficult to follow the precise effect of the former. During the period discussed (1977-1992), sharp variations of stock abundance were observed both within and outside the zone. During those years anomalous deviations of environmental conditions were found several times. During some periods a sharp increase in fishery effort was observed for the species, fished outside the zone. Thus, the current situation in the area becomes very confusing from the point of view of fish stock management efficiency.

In the present paper an attempt is made to summarize and analyze the above-mentioned situation in NAFO Subareas 2-4 during 1977-1992 and to reveal the whole event picture, which in turn will facilitate measures on rational management and protection of fishery resources in the area.

Materials

Information for subsequent analysis was obtained from NAFO and CAFSAC scientific documents which provide estimates of almost all major commercial fish stocks in NAFO Subareas 2-4. The appropriate data sources are listed below.

Species	NAFO Area and Zone	Reference
NAFO Scientific Council Research Documents (SCR)		
Cod	2J3KL	Bishop *et al.*, MS 1993
Cod	3NO	Davis *et al.*, MS 1993
Cod	3M	Vazquez, MS 1993
Silver hake	4VWX	Showell *et al.*, MS 1993
Redfish	3M	Gorchinsky and Power, MS 1993
Yellowtail flounder	3LNO	Brodie *et al.*, MS 1993
Witch flounder	3NO	Bowering *et al.*, MS 1993
American plaice	3LNO	Brodie *et al.*, MS 1993
Greenland halibut	2+3KL	Bowering *et al.*, MS 1993
Capelin	3NO	Miller, MS 1993
CAFSAC Research Documents		
Cod	2GH	Murphy *et al.*, MS 1992
Cod	3Pc	Bishop and Murphy, MS 1992
Cod	4TVn	Hanson *et al.*, MS 1992
Cod	4VsW	Mohn and MacEachern, MS 1992
Haddock	3NO and 3Ps	Bishop and Murphy, MS 1992
Haddock	4TVW	Zwanenburg, MS 1992
Haddock	4X	Hurley *et al.*, MS 1992
Pollock	3Ps	Bishop and Murphy, MS 1992
Pollock	4VWX + 5Zc	Annand and Beanlands, MS 1992
Herring	4T	Claytor *et al.*, MS 1992
Herring	4WX	Stephenson *et al.*, MS 1992
Capelin	2J3KL	Carscadden, MS 1992

As is seen, the list of species lacks the redfish stock from Div. 3LN, the state of which is very difficult to classify due to high interannual variability of abundance and migrations into Div. 3O.

Dynamics of Commercial Fish Stock State in the Northwest Atlantic

The above listed stock units are characterized by abundance which may vary from extremely low to very high values. This range includes, as well, a series of intermediate states. According to the task determined, it was decided to consider instead of individual stock units, three groups of stocks classified according to abundance level in 1991-92 and 1977-90 (Tables 1 and 2). Selection of 2-year periods is stipulated by the fact that those years are characterized by sharp (and for some important commercial species by catastrophic) abundance decreases, which resulted in very strict measures undertaken by Canada and NAFO to restrict the catch of the latter, including a moratorium enforcement.

As it could be seen, Table 1 has a note which requires some explanations. Let us start with cod in 2J+3KL. It seems that all available information shows the collapse of the stock complex. However, disappearance of all large mature fish during one year is surprising. The convincing evidence of mass mortality of the latter during such a short period were not obtained. It could be hardly supposed that the above-mentioned situation is possible for the species considered. However, there is some evidence of large cod concentrations in 1992 on the depths which greatly exceed optimum ones for these species (Bishop *et al.*, MS 1993). This event may be related to an anomalous water temperature decrease in 1991-1992 (Drinkwater, MS 1993). The above-mentioned data seems to provide evidence that abundance decrease in the area was not a collapse as the research results show. Similar doubt appears in relation to cod stocks in Div. 3Ps, 4TVn and 4VsW where unusual distribution of concentrations were found in 1991-1992 (Bishop and Murphy, MS 1992; Hanson *et al.*, MS 1992; Mohn and MacEachern, MS 1992).

The situation of silver hake in Div. 4VWX is also somewhat unclear. The distribution and behaviour factor, which is not considered in stock assessment, may affect the fishery and research abundance indices of the latter, however, the stock decrease in 1991-1993 is undoubtfull (Showell *et al.*, MS 1993). Detection of large Greenland halibut aggregations in the Regulatory Area during the early-1990s, accompanied by some decrease of the species in the zone (Bowering *et al.*, MS 1993), also provides evidence of the effect of cooling on halibut distribution and behaviour, while the stock size of the latter seems to remain the same. As a whole, data of Table 1 show that the bulk of stock units was at a low level in 1991-1992.

Now let us consider the general stock state during a preceding period (Table 2). As it could be seen the situation was quite different. In the 1980s the abundance level was high, almost or at least satisfactory, in all species. Stock size of some species seems to remain the same (in good or satisfactory state) during the entire discussed period (1977-1992). The latter were fished only within the 200-mile zone, except the Greenland halibut, significant catches of which were obtained from the Regulatory Area since 1990. However, the trend to stock size decreases of three flounder species, redfish in Div. 3M and cod in Div. 3NO (intense fishery of which was conducted outside the zone) was observed already in the second half of the 1980s.

Supposed Causes of Fish Resource Abundance Variability in 1977-1992

New evidence hardly may be found, while considering abundance dynamics of each population individually in detailed research area of the Northwest Atlantic.

Thus, the attempt was made to summarize all supposed causes based on classification of species into groups according to their geographical location, taking into account the 200-mile zone (Table 3).

Comparison of data from Tables 1 and 3 shows that the first group (Table 3) is represented by populations of low and very low levels in 1991-1992, except the herring in Div. 4T. The same is true for all stock sizes of the third group, excluding the Greenland halibut. On the contrary, the second group consists of stock units which are mainly in good and satisfactory states.

The above information seems to suppose some considerations on the reasons of abundance variations in each group (Table 3). Thus it is possible that in the first group, distributed in the northern peripheral part of the Area and 200-mile zone, cooling of NAFO Subareas 2-4 in late-1980s and early-1990s became the major cause of depression (Sigaev, MS 1991; Drinkwater, MS 1993). There is no evidence of significant fishery effect in that case, since the uniform system of fishery management enforced by Canada in its zone should result in similar effect of the latter over all species. However, abundance of some stock units of the second group (Table 3) remained at a good or satisfactory level during the entire period (Tables 1 and 2), i.e. the above-mentioned cooling resulted in no significant adverse consequences in relation to some stocks, while the fishing mortality rate was mainly close to an optimum value. It should be noted that the latter is not synonymous to the criteria of $F_{0.1}$ and varies according to a stock state (Rikhter, 1981).

As to the third group of stocks (Table 3) which had been affected by unregulated fishery for several years, the effect of a high fishing mortality on their abundance level seems quite possible, while the environmental factors also could not be excluded.

Possible Fishery Management Measures in NAFO Subareas 2, 3 and 4

Let us consider the first group of stock units (Table 3), the evidence of which is mainly affected by oceanographic factors. If it is so, then at persistent unfavourable conditions for young fishes, even total fishery prohibition will not improve the situation. However, when the first strong year-class appears after a depression, strict measures should be enforced to protect the latter from early capture if such danger exists. In such cases a stock recovery process will be maximum. As to the scientific research, special attention should be payed to prediction and studying of influence of oceanographic factors on fish year-class abundance for the given group.

State of most populations from the central part of the area and zone seems less dependent on the environmental factors as compared to the fishery removal rate. The second group's abundance dynamics supposes that the Canadian system of fishery management appears rather efficient during entire discussed period. In relation to such stock units, the optimum fishing mortality maintenance seems to be the major method of abundance control. Besides, the environmental factors possible effect on the young fishes survival and adults distribution could not be excluded.

Fishery affects mostly populations distributed entirely or partially within the Regulatory Area. The danger of overfishing is rather strong here and the basic method of fishery management of the third group of stocks is a strict control over fishery regulations observation. The above-mentioned role of a fixed fishing mortality level and environmental factor consideration is important in that case also.

Conclusion

Considerations on the present state of some commercial fish stocks, particularly of cod, presented in the paper seem not incontestable. However, we suppose the discussion of the problem to be very useful as it promotes appropriate research. Thus events during the early-1990s contemplate the necessity to pay more attention to environmental factors effect on young fish distribution and adult fish behaviour for major commercial species. The results of the analysis carried out suppose that optimum utilization of fishery resources alone could not ensure protection and long-term sustained exploitation of most stock units from NAFO Subareas 2-4. Certainly at stable conditions rational fishery management strategy is fully justified. However, as we found, environmental anomalies within the area may sharply affect situations within few years. Significant decreases of several population abundances in the early-1990s is an impressive example of the latter. It is hard to predict the depression duration. The experience of preceding years shows that processes of decrease and increase in the area occur during relatively short periods (about 10 years). Thus it could be supposed that abundance of most commercial fish stocks will start to recover in the current decade.

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TABLE 1. Commercial stock units abundance level in NAFO Subareas 2, 3 and 4 in 1991-1992.

High or satisfactory	Low	Very low
Cod 3Ps[1]	Cod 2J+3KL[1]	Cod
Cod 4TVn[1]	Cod 3NO	Cod 3M
Cod 4VsW[1]	Pollock 3Ps	Haddock 3NO
Pollock 4VWX + 5Zc	Haddock 4TVW	Haddock 3Ps
Herring 4T	Herring 4X	American plaice 3LNO
Herring 4WX	Silver hake 4VWX[1]	Capelin 2J+3KL
Greenland halibut 2+3KLM	Redfish 3M	Capelin 3NO
	Yellowtail flounder 3LNO	
	Witch flounder 3NO	

[1] Stock estimate of the species is unreliable.

TABLE 2. Commercial stock units abundance level in NAFO Subareas 2, 3 and 4 in 1977-1990.

Periods/Years	High or satisfactory	Periods/Years	Low	Periods/Years	Very low
1981-1990	Cod 2J+3KL				
1977-1986	Cod 3NO				
1978-1990	Cod 3Ps	1977-1990	Pollock 3Ps	1987-1990	Cod 2GH
1977-1990	Cod 4TVn				
1977-1990	Cod 4VsW				
1977-1990	Pollock 4VWX + 5Zc				
1982-1990	Herring 4T				
1981-1990	Herring 4WX				
1982-1988	Haddock 3NO				
1982-1989	Haddock 3Ps				
1979-1990	Haddock 4TVW				
1977-1986	Haddock 4X				
1989-1990	Silver hake 4VWX				
1977-1987	Yellowtail flounder 3LNO				
1977-1986	American plaice 3LNO				
1982-1988	Witch flounder 3NO				
1978-1990	Greenland halibut 2+3KLM				
1982-1990	Capelin 2J+3KL				
1981-1988	Capelin 3NO				

TABLE 3. Stock units separation in NAFO Subareas 2, 3 and 4 according to geographic pattern.

Distributed in the northern edge of the species area and 200-mile zone	Distributed in the middle of the species area and 200-mile zone	Partially or entirely distributed in the Regulation Area
Cod 2GH	Cod 2J+3KL	Cod 3M
Haddock 3NO	Cod 3Ps	Cod 3NO
Haddock 3Ps	Cod 4TVn	Yellowtail flounder 3LNO
Pollock 3Ps	Cod 4VsW	American plaice 3LNO
Silver hake 4VWX	Pollock 4VWX + 5Zc	Witch flounder 3NO
Capelin 2J+3KL	Haddock 4TVW	Redfish 3M
Herring 4T	Haddock 4X	Capelin 3NO
	Herring 4WX	Greenland halibut 2+3KLM