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An Assessment of the Cod Stock in NAFO Division 3M

by

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Introduction

From 1974, when a TAC was first established, to 1979, catches ranged from 22 000 to 33 000 tons. Catches had been at that level or higher for the previous ten years. The TAC was 13 000 tons for 1980-87, while the reported nominal catches were about 12 000 tons.

A moratorium on the Flemish Cap cod fishery was established by the Fisheries Commission for 1988 to 1990. However, catches for 1989 and 1990 have been estimated to be about 40 000 and 32 000 tons, respectively. Reported catches for 1989 and 1990 were about 1 000 and 2 000 tons, respectively. No estimate of unreported catches were available for 1988, but it is believed that actual catches also exceeded those reported for that year.

Catch trends

Cod catches in last three year were:

	1991	1992	1993
Faroes	1 943		
Japan	54		
Norway	795		
Portugal	2 838	2 201	3 130
Russia	1	1	
Spain	1 416	4 215	2 249
UK	26		
Others	1 277		
Total	8 356	6 417	5 379
Total estimated	11 000	11 000	12 500

The "total estimated" figure is an overall catch estimation, independent from reported nominal catches, and includes catch estimates for non-member countries.

Sampling data

Sampling catch data are available for Portuguese trawlers and gillnetters and Spanish pair-trawlers. Samples were collected from the whole catch in all cases, that is to say, before catch was sorted and discards were retired. Gillnetter catches were dominated by 1985 and 1986 year-classes, which had been relatively abundant. Those year-classes are not significant in trawl catches, which are based on younger age-groups. Pair-trawl catches were based

on the 1989 and the most abundant 1990 year-classes. Other trawl catches are based on the relatively abundant 1990 year-class. Non-reported catches age composition was estimated as for 1992 been equal to Portuguese trawlers and Spanish pair-trawlers in same amount. Catch-at-age calculated in this way (Table 1) is considered a rough estimate, but it is included for comparison with stock age composition estimate.

The stock was dominated in 1993 by small fish of the 1990 year-class, that appeared as relatively abundant in surveys. Nevertheless, catches were not so directed to small fish as it was in 1992. Estimated total catch in numbers ('000) from 1992 and 1993 are:

Age	1992	1993
1	9	0
2	6 903	804
3	5 844	7 104
4	2 148	3 155
5	348	1 183
6	954	309
7	185	498
8	14	278
9	1	6
10	0	1
11	1	4
12	0	0
Catch (t)	11 000	12 500

The 1990, 1989 and 1988 year-classes dominate the catches in both years, but catches in 1993 shift to older age-groups than in 1992.

Survey results

Two surveys were made during 1993: the Russian trawl-acoustic survey, carried out in June-July on board R/V *Vilnyus*, and the EU bottom trawl survey, carried out in July on board R/V *Cornide de Saavedra*. Both surveys are continuation of two independent series. Cod biomass estimates (tons) are summarized in the following table:

Year	EU[1]	Russia[2]	Russia[3]
1983		23 070	
1984		31 210	
1985		28 070	
1986		26 060	
1987		10 150	21 600
1988	37 127	7 720	34 200
1989	103 644	36 520	78 300
1990	55 360	3 920	15 200
1991	36 597	6 740	8 200
1992	24 295		2 500
1993	55 642	13 020	13 820

[1] Biomass estimated from bottom trawl survey (Vazquez, 1994)
[2] Biomass estimated from bottom trawl survey (Kiseleva and Vaskov, 1994)
[3] Russian estimates of bottom trawlable plus pelagic biomass (Kiseleva and Vaskov, 1994)

Both surveys indicate a maximum of stock biomass in 1989, when abundant 1985 and 1986 year-classes had 4 and 3 years, respectively. Both surveys also indicated that bottom trawlable biomass in 1993 was at the second highest level since 1988. The increase in biomass from 1992 to 1993 must be attributed to the income of two relatively abundant year-classes, those of 1990 and 1991, which constitute a 89% of total biomass according to EU survey results.

Abundance decrease of each cohort in EU survey (Vazquez, 1994), expressed by its fishing mortality coefficient equivalence, is presented in Table 3. Age 3 is the class with the highest decrease in both 1991 and 1992. This is in contrast with the mean situation over the period where ages 5 and 6 suffer the highest decrease.

Partial recruitment corresponding to the estimated total annual catch and based on stock structure according surveys results in presented in Table 2. Differences are partially due to the smaller efficiency of the Russian survey to catch small fish than the EU survey. The partial recruitment calculated based on EU survey results indicated a concentration of effort on 4-year-old cod, also observed with 1992 catch data:

Year	1	2	3	4	5	6	7	8	9	10	11	12
1992	0.00	0.20	1.30	1.12	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
1993	0.00	0.00	0.22	2.77	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00

The previous conclusions: age 3 being the class with highest decrease from survey to survey and age 4 being the class that supports the highest effort, are not contradictory. Surveys were made in July and catches on age-class 4 in the first half of the year, when most of the catch is made, contributed to the decrease of the nominated age-class 3 of the previous survey.

Biomass age 5+ is a rough estimate of spawning biomass (Gonzalez and Larraneta, 1994). Total and age 5+ biomass according EU survey was:

	Biomass (t)	
Year	Total	Age 5+
1988	37 127	4 218
1989	103 644	32 345
1990	55 360	34 259
1991	36 597	16 218
1992	24 295	4 543
1993	55 642	5 599

Assessment

The abundance of older than 5 years cod is low on Flemish Cap as a consequence of a very high fishing mortality on recent years. The fishable stock is mainly composed of small fish. This is an inadequate state for a proper exploitation of the resource, and the situation would remain unchanged at the current fishing activity level.

A trawl fishery in 1995 would be based on the 1990 and 1991 year-classes when 5 and 4-year-old respectively if the current fishing pattern is maintained. These two year-classes will also support the fishery in 1994, and their contribution to the gillnet fishery will increase along the time. Both year-classes appeared relatively abundant in the Russian and in the EU surveys when age 2 and 3.

Spawning stock biomass is at a low level, and it is expected to increase in 1995 when the 1990 year-class be 5 years old. A later increase is expected in 1996 when the 1991 year-class reaches 5 years old. These improvements of the spawning stock in the next future will be based on the abundance of the year-classes supporting the fishery in 1994 and 1995. If the abundance of both year-classes is not so high as survey results seem to indicate, or it is substantially reduced by fishing activity during 1993 and 1994, the recovery of the stock will be postponed.

References

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TABLE 1. Cod catch-at-age in 1993 ('000).

Age	Spanish PTB	Portuguese OTB	Portuguese GNS	Other catches	Total	m.w. (gr)
1 -	0	0	0	0	0	0
2 -	347	151	0	306	804	216
3 -	854	2 205	7	4 038	7 104	518
4 -	794	818	1	1 542	3 155	929
5 -	186	316	12	669	1 183	1 791
6 -	24	70	10	205	309	2 234
7 -	45	86	24	343	498	3 204
8 -	22	29	20	207	278	4 379
9 -	2	1	0	3	6	6 829
10 -	0	0	0	1	1	12 160
11 -	0	1	0	3	4	9 827
12 -	0	0	0	0	0	8 670
Catch (t)	2 241	2 905	225	7 129	12 500	

TABLE 2. Cod catch-at-age compared with stock structure according EU and Russian 1993 surveys (P.R. = partial recruitment).

Age	Total catch ('000)	EU Survey	EU P.R.	Russia Survey	Russia P.R.
1 -	0	438	0.00	0	0.00
2 -	804	13 274	0.00	449	0.06
3 -	7 104	2 852	0.22	322	0.78
4 -	3 155	102	2.77	149	0.75
5 -	1 183	127	1.00	61	1.00
6 -	309	17	1.00	12	1.00
7 -	498	50	1.00	4	1.00
8 -	278	10	1.00	4	1.00
9 -	6		1.00		1.00
10 -	1		1.00		1.00
11 -	4		1.00		1.00
12 -	0		1.00		1.00

TABLE 3. Indices for cohort abundance decease calculated as fishing mortality coefficients between consecutive EU survey estimates.

mean : unweighted mean over years
F 3+ : weighted by abundance at age
Y 3+ : catch corresponding to F3+ and July to July

Age	1988	1989	1990	1991	1992	1993	Mean
1 :	-1.08	0.37	-2.58	1.11	-0.82		-0.60
2 :	-0.36	0.66	-0.47	1.48	0.06		0.27
3 :	-0.40	1.47	0.69	1.83	1.34		0.99
4 :	-0.74	1.02	0.74	1.56	0.27		0.57
5 :	-0.19	1.35	1.93	1.39	0.46		0.99
6 :	0.18	1.18	2.56	1.91	0.73		1.11
7 :	0.65	-0.06	3.27	3.02	0.54		1.48
8 :		0.21	0.98				0.60
9 :							
10 :			0.90				0.90
11 :							
12 :							
F 3+	-0.47	1.28	1.16	1.69	0.83		
Y 3+	-13 338	63 039	35 216	19 272	4 437		
Catch (t)	40 000	32 000	11 000	11 000	12 000		