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An Attempt to Estimate Environmental Influences on the Distribution of Cod (Div. 2J)

by

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Introduction

At the June 1984 Meeting of the Scientific Council the Standing Committee on Fishery Science (STACFIS) agreed to set up an ad hoc working group to provide a review of the problem of environmentally - induced variations to stock assessments. During the last meeting of the working group in September 1985 at the NAFO Secretariat in Dartmouth, Nova Scotia, Canada, the group decided to provide STACFIS at the June 1986 Meeting with documentation on catchability problems and anomalies in biological and hydrographic time series of data (NAFO Scientific Council Reports 1985, p. 116). For the present paper the authors reviewed the biological and hydrographic time series of the groundfish surveys off Labrador conducted by the Federal Republic of Germany from 1972 to 1985 during the autumn season.

Material and Methods

As a first attempt to estimate possible environmentally - induced variations on the distribution of cod in NAFO Div. 2J one of the most exceptional years according to survey results, 1981, was chosen for further consideration. From the hydrographic observations obtained during the bottom trawl survey in 1981 the bottom temperatures measured at the individual trawl positions were included in the analysis. The bottom topography, contoured at 200 m, 500 m and 1000 m was taken as the basis for displaying survey catches of cod versus bottom temperature °C (fig.1). A total of 69 hauls were performed in Div. 2J which are grouped as "zero" catch of cod, less than 100, 500, 1000, 2000 and 5000 kg. The largest catch was 4200 kg of cod.

Results and Discussion

The distribution of bottom temperature indicates a meandering frontal system

which follows the bathymetric contours north and south of Hamilton Bank. This picture reflects the coexistence of the cold and fresh nearshore component of the Labrador Current originating from Baffin Bay as the Baffin Island or Canadian Current (LAZIER, 1982) and the warm and haline waters arising from the Irminger Current. The path of the isotherms suggest the steering influence of the bottom topography on the distribution of water masses. Similar meandering south of Hamilton Bank was observed during the 1974 and 1975 autumn surveys of the Federal Republic of Germany (STEIN, 1975; STEIN, 1976) and of the German Democratic Republic 1979, autumn survey (VERCH, 1980). The observation periods of the cited surveys are listed below.

Table 1: Groundfish surveys with observed meandering north and/or south of Hamilton Bank (Div. 2J)

Period	Meander	
	north	south
29. Nov. - 8 Dec. 1974	-	+
23 Nov. - 8 Dec. 1975	-	+
29 Nov. - 13 Dec. 1979	-	+
10 Nov. - 19 Dec. 1981	+	+

Concerning the "northern" meander during the 1981 survey (Fig.1) the size of this warm water tongue coincides with the gap between Hamilton Bank and Harrison Bank. To resolve a pattern of this size more reliably the grid of observations should be in the small-scale range of 10 to 20 nautical miles. This demand, however, is seldom fulfilled during a survey based on a stratified-random sampling design. Thus, one must either rely on lucky occasions in meeting a meander by chance, or, one has to change the strategy of the environmental survey to the extent that peculiarities of the area like topographic features will be covered by small scale grids of observation.

The mean catches of cod per 30 minutes within the different temperature zones as derived from survey data in autumn 1981 are analysed in Table 2. A large variability of catches is reflected by very high variances especially within the temperature strata 1-2°C and 2-3°C which are mainly caused by only five extreme catches ranging from 572 to 4200 Kg per 30 minutes. These catches were obtained close to the 200 m depth contour within a depth range of 170-287 m and were located on both flanks of the "northern meander" of warm water close to or within the frontal zone formed by the 2° and 3° isotherms (see Fig. 1). The exclusion of these five extreme catches from the evaluation results in a considerable reduction of the mean catches but also of their variances (lower set of figures in table 2).

There was, however, no possibility to estimate the areas of the respective temperature strata and hence to calculate a corresponding weighted mean

catch for the total survey area. Therefore the respective weighted mean catches as derived by the original stratification are also given in Table 2 for comparison. Although the exclusion of the extreme catches also resulted in a considerable reduction of the weighted mean catch and consequently of the minimum trawlable biomass of cod for the total survey area from 204000 to 122000 tons by 40 % there still remained an increase by 36 % against the corresponding values obtained for the preceding year, 1980, and the continuing trend of increasing stock size of cod observed until 1983 (MESSTORFF, 1985) and even until 1985 seems to be more reliably reflected by a much lower variance.

The possibility that the encounter of local concentrations of cod induced by environmental conditions during survey operations may involve the risk of overestimation of the survey biomass and abundance can therefore not be excluded. However, further analyses of such phenomena are necessary to test and perhaps prove the suggested interrelations.

References

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Table 2. Survey results 1981 (AD 113): Number of hauls (N), mean catch of cod per 30 minutes (\bar{x}), standard deviation of the mean ($s_{\bar{x}}$) and confidence interval ($\pm\%$) re temperature zones

	T < 1°C	T: 1° - 2°C	T: 2° - 3°C	T > 3°C	Total survey area
N	8	22	19	20	69
\bar{x}	207.13 kg	438.52 kg	238.80 kg	58.33 kg	253.04 kg
$s_{\bar{x}}$	50.61	187.81	79.38	18.62	117.96
$\pm\%$	57.78	89.06	69.84	66.82	46.62
N		20	16		64
\bar{x}		209.03 kg	107.58 kg		151.58 kg
$s_{\bar{x}}$		32.74	25.06		27.87
$\pm\%$		32.78	49.66		18.37

confidence intervals at 95 % significance level

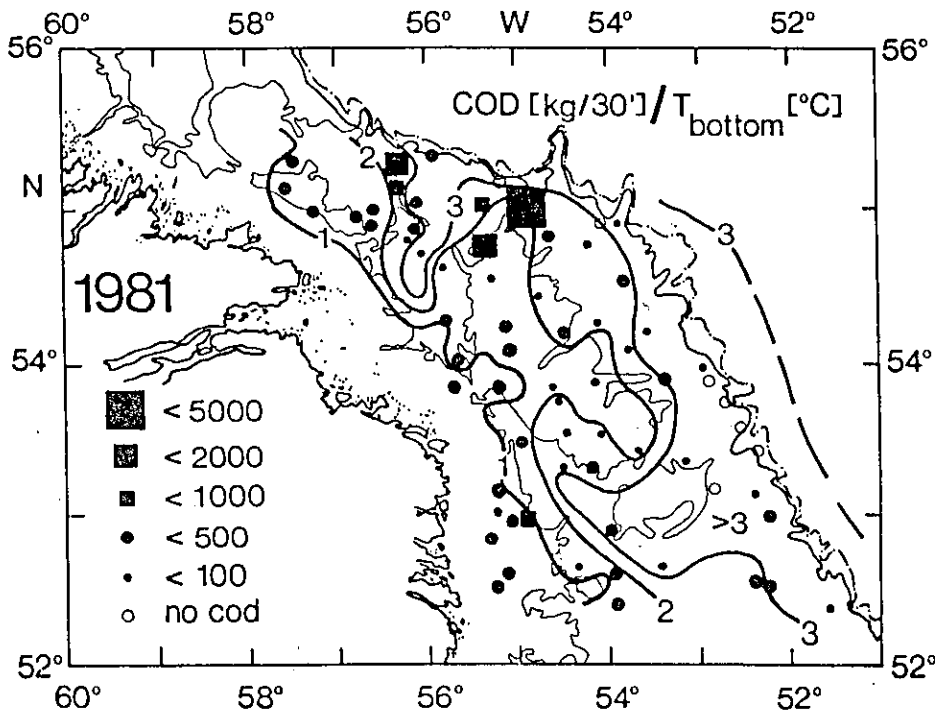


Fig. 1: Distribution of cod and bottom temperature (Div. 2J) between 10 November and 19 December 1981 (bottom topography contoured at 200 m -, 500 m -, 1000 m -.-)