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Recruitment of Cod in Div. 2J+3KL and the Physical Environment

by

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INTRODUCTION

In this paper cod recruitment is related to spawning stock biomass (SSB) and to several physical factors. Recruitment has been taken as the population number at age 4 (N_4) according to the cohort analysis carried out by Baird and Bishop (1986). SSBs were taken from de same cohort analysis. The physical factors studied were the percent decrease in solar constant (Larrañeta and Vázquez, 1982), the radius of the polar motion (Larrañeta and Vázquez, 1985), and the temperature and salinity between 0-170 meters in the Northwest Atlantic Centre ocean climate station 27 (47°33'N, 52°35'W), according to Akenhead (1983). The temperature and salinity data used are the average of 1, 2, 3, 4, 6 and 12 month periods.

The strength (N_4) of each year class was related to variables in the same calendar year, and also with variables of years with lags from -3 to 3 calendar years. In this study a negative lag means years before the year class, and a positive lag years after the year class.

RESULTS

No significant correlation coefficient was found between recruitment values and the percent decrease in solar constant, nor with the radius of polar motion. The decrease in the solar constant was taken as a general factor in the dynamics of the ocean. The authors (1982, 1985) have found some relationships between polar motion and year class strength of the Atlantic cod in the Arctic Ocean.

The significant correlation coefficients ($P<0.01$) between recruitment and SSB are shown in Table 1, between recruitment and temperature in Table 2, and between recruitment and salinity in Table 3. The Student "t" test was used as a test of significance.

Multiple correlations have been calculated by choosing two series, (i) by selection of the highest correlation coefficients

in each variable, and (ii) selecting the highest correlation coefficients of each variable measured during the first year of each year class. To produce series (i) the variables used were, SSB 7+, 1 year lag; January temperature, 3 year lag; and August salinity, 1 year lag. To produce series (ii) the variables were, SSB 8+, 0 year lag; January temperature, 1 year lag; and August salinity, 0 year lag. Parameters of the multiple regressions are shown in Table 4.

The variables have been computed as follows:
Recruitment as $N_4 \times 10^{-5}$.

SSB as metric tons x 10^{-2}.

Temperature in degrees Centigrade.

Salinity of the decimal part of Akenhead's data considered as a whole number; when salinity is less than 32.00 a negative number results.

DISCUSSION

In Tables 2 and 3, surprisingly more and larger significant correlations appear when there is a lag than when there is not. In this paper we do not offer any hypothesis to explain the high correlations with lags, even with a lag of 3 years. Nevertheless, it must be pointed out that all these correlations have a positive lag. This suggests that the critical period may be longer than is normally admitted. One other point is that all correlations are positive, which means that during the period 1962-1980 the greater the SSB, temperature, or salinity, the greater was recruitment.

The multiple regression (i), in which the highest correlation coefficients are selected, regardless of whether they were or were not measured during the first year of life of the year class, seems less logical than the multiple regression (ii), where all the variables were measured during the first year of life. Despite the fact that series (i) contains higher coefficients than series (ii), the combination of the three variables in series (ii) accounts for a larger proportion (84%) of the variation of recruitment than the combination in series (i) (69%).

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Table 1. Correlation between recruitment and SSB.

SSB ages	Lag	r	"t"	d.f.	P<
6+	-1	.674	3.647	16	.01
6+	0	.783	5.183	17	.001
6+	1	.806	5.607	17	.001
6+	2	.730	4.410	17	.001
6+	3	.681	3.832	17	.01
7+	-1	.717	4.118	16	.001
7+	0	.795	5.401	17	.001
7+	1	.820	5.903	17	.001
7+	2	.743	4.584	17	.001
7+	3	.692	3.952	17	.01
8+	-2	.669	3.488	15	.01
8+	-1	.779	4.963	16	.001
8+	0	.817	5.842	17	.001
8+	1	.810	5.689	17	.001
8+	2	.723	4.309	17	.001
8+	3	.693	3.959	17	.01

Table 2. Correlation between recruitment and temperature

Month	Lag	r	"t"	d.f.	P<
Jan	1	.653	3.853	20	.001
Jan	2	.668	3.910	19	.001
Jan	3	.761	4.973	18	.001
Feb	3	.595	3.138	18	.01
Jan-Feb	1	.563	3.048	20	.01
Jan-Feb	2	.596	3.237	19	.01
Jan-Feb	3	.734	4.582	18	.001
Jan-Mar	2	.572	3.039	19	.01
Jan-Mar	3	.727	4.490	18	.001
Jan-Apr	3	.686	3.889	17	.01
Jan-Jun	3	.627	3.317	17	.01

Table 3. Correlation between recruitment and salinity

Month	Lag	r	"t"	d.f.	P<
Aug	0	.628	3.609	20	.01
Aug	1	.692	4.175	19	.001
Sep	2	.560	2.944	19	.01
Dec	1	.616	3.131	16	.01
Jul-Sep	1	.625	3.486	19	.01
Sep-Dec	1	.603	3.020	16	.01
Jul-Dec	1	.662	3.533	16	.01

Table 4. Parameters of the multiple regressions.

Series (i)

X_1= SSB 7+, lag 1 a_1= .607

X_2= Temp Jan, lag 3 a_2=-1077.102

X_3= Sal Aug, lag 1 a_3= 27.133

a_0=-1304.600

Number of values= 17

$\frac{\text{Variation expl.}}{\text{Total variation}}$ =.69

Series (ii)

X_1= SSB 8+, lag 0 a_1= .565

X_2= Temp Jan, lag 1 a_2= 333.570

X_3= Sal Aug, lag 0 a_3= 83.232

a_o=-3237.727

Number of values= 18

$\frac{\text{Variation expl.}}{\text{Total variation}}$ =.84

$$R = a_o + X_1a_1 + X_2a_2 + X_3a_3$$