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Abundance Fluctuations of Fishery Stocks of Cod and Haddock on the Grand Bank of Newfoundland

by

Konstantinov, K.G.
The Polar Research Institute of Marine Fisheries and Oceanography (PINRO), Murmansk, USSR.

A B S T R A C T

to the paper by Konstantinov K.G. " Abundance Fluctuations of Fishery Stocks of Cod and Haddock on the Grand Bank of Newfoundland "

On the southern Grand Bank of Newfoundland and on the St.Pierre Bank the abundance of fishery stocks of haddock increases after hydrologically warm years, when the most abundant year classes appear. Contrary, anomalous cooling of water masses causes the reduction of haddock abundance growth. It is pointed out, that the inverse proportional dependence with correlation coefficient r=- 0.66 is between the abundances of cod and haddock on the Grand Bank. The equation expressing this dependence approximately permits to foreknow the expected cod catches based on the actual haddock catches.

Regular assessment on the young commercial fishes on the Grand Newfoundland Bank showed that the abundance of cod year classes had been fluctuated within a rather considerable range. As it is seen from Table 1, the young cod quantity of the rich year classes on the Grand Bank was 40-50 times greater compared to that of poor year classes.

It should be pointed out that not all the populations of Atlantic cod were characterised by similar sharp fluctuations as the cod populations from the Grand Bank. For instance, the year classes of the Labrador cod were considerably stable (Bulatova, 1968; Konstantinov, 1969; Postolaky, 1971); the cod abundance ratio between the richest and poorest year classes was not higher than 1:5.

Well-defined fluctuations do naturally affect the cod fishery on the Grand Bank. For instance, the extreme abundance of the 1964 year class (Table 1) caused the increase of cod catches in Division 3NO from 80 thsd.t in 1963-1966 to 220 thsd.t in 1967 (Pinhorn & Wells, 1970).

A set of many populations showed that the abundance of fishes-spawners does not noticebly influence upon the strength of the progeny. For instance, in 1966, 1967 and 1968 the number of matured fishes in Labrador cod population was comparatively low (Postelaky, 1971), however, the richest generations appeared just in these years. It is seen from Table 2, representing the quantity of the young in Division 3K, where the Labrador cod distribute at the age of 3 years.

There are the reasons to consider that the abundance of the year classes is determined by the environmental conditions, affected the eggs, larvae and fry survival. Templeman (1965) showed that the abundant haddock year classes appeared on the southern Grand Bank during the warming up of water masses. Indeed, in May 1966, 1967

an increased water temperature was registered on the southern Grand Bank (Table 3), and during those years fairly rich haddock generations appeared in Division $3P_s$ (Table 4).

In the seas of the European North both the cod and haddock are also characterised by the highest fecundity in hydrologically warm years. It is necessary to mention that the distribution of these fishes in the North European Seas is practically similar. Both cod and haddock occurred in the southern Barents Sea, on the Bear Island-Spitsbergen Shallows, off the Norwegian Coast, in Icelandic waters and in the North Sea.

In contrast to the seas of the North European Basin the areas of mass distribution of cod and haddock in the Northwest Atlantic do not coincide.
F i s h e r y a r e a s of cod and haddock, i.e. the areas, where these species are of p a r a m o u n t c o m m e r c i a l v a l u e are shown in Fig.1. Certainly, cod distribution also covers the area southward of Cabot Strait up to the coast of New Jersey and North Carolina States (Wise, 1958). Rarely haddock occurred off the Greenland coast (Meyer, 1961, 1962, 1964). However, in the present paper the problem on dynamics of the f i s h e r y s t o c k s is considered, therefore we are interested only in the area of mass distribution of cod and haddock, where they always (or periodically) dominate in the fishery catches.

It maybe affirmed that on the Grand Bank (to be more precise, in Division 3NO) haddock inhabited off the northern boundary of their mass distribution. Warming up of the water masses on the Grand Bank of Newfoundland approaches the habitat conditions of haddock to be the optimal (typical for more southern areas, where the centre of the range is situated). No wonder that namely in hydrologically warm years on the Grand Bank the most abundant haddock year classes are registered.

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Contrary, for the reproduction of the Grand Bank cod a little lower temperature is favourable, that is typical for more northern areas of Atlantic.

Thus, the abundances of cod and haddock on the Grand Bank have to change by inverse: in the period of cod stocks increase it is naturally to expect for haddock stocks decrease and vice versa. To control this it is necessary to have the assessment on catches statistics. However, it has to remember that haddock enter the fishery at earlier age than the cod. Therefore, in Fig.2, where the cod and haddock catches are represented, the time scale is displaced by one year; it permits easily to compare, for example, the catch of haddock taken in 1953 with cod catch taken in 1954.

Such comparison shows that the stocks of cod and haddock on the Grand Bank really fluctuate by inverse. In particular, an unusual high increase of cod stocks and a deep depression of haddock stocks are typical for the last five years. The start of such differences was founded in 1962-1963, when on the southern Grand Bank a sharp cooling of water masses took place (Table3).

It is seen from the same table, that in 1969 on the southern Grand Bank a noticeble warming up took place, probably, it was caused by the strengthening of the Gulf Stream; a year later the warming up was registered off the North Europe and caused the high abundance of the year classes of cod and haddock of Arcto-Norwegian stock, in full conformity with Templeman's views (1965). In 1969 on the Grand Bank of Newfoundland a poor cod generation appeared (Table 1), whereas on the St.Pierre Bank a little richer haddock generation was registered, compared to 1968 (Table 4).

An inverse dependence between the catches of cod and haddock in Division 3NO can be expressed by the correlation equation:

$$y_{i+1} = -1.46x_i + 131824 ,$$

where x_i - annual haddock catch (in metric tons),

y_{i+1} - cod catch/next calendar year.

Correlation coefficient r = -0.66;

E = 0.094;

$\frac{r}{E}$ = 7.1;

n = 16.

Equation supposed can be useful for approximate forecasting the cod catches on the southern Grand Bank of Newfoundland.

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Wise,J.P. 1958. The world's southernmost indigenous cod.
J.Conseil perm.internat.explorat.mer., 23,No.2:208-212.

Table 1

Average catch (number of specimens) of the young cod at the age of 1,2 and 3 years per one hour-trawling (fish-counting trawl)

Year class	I year		2 years		3 years	
	3N	30	3N	30	3N	30
I959					8	I
I960			3	0	I	2
I96I	I	I	4	3	5	I
I962	I	7	8	2	I8	2
I963	I	I	5	I	30	I
I964	4I	24	I37	I3	73	42
I965	I	I	I4	I2	23	20
I966	2	I5	27	I7	37	34
I967	I	2	3	4	32	I4
I968	6	I8	I09	28	9I	23
I969	2	4	II	6		
I970	6	I				

Table 2

Average catch (number of specimens) of the young cod of 3 years aged per one hour-trawling in Division 3K (fish-counting trawl)

Year class	Number of 3 year olds per one hour-trawling
I959	2I
I960	II
I96I	20
I962	I5
I963	36
I964	8
I965	I5
I966	27
I967	32
I968	40

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Year class	1 year		2 years		3 years	
	3N	30	3N	30	3N	30
1959					8	1
1960			3	0	1	2
1961	1	1	4	3	5	1
1962	1	7	8	2	18	2
1963	1	1	5	1	30	1
1964	41	24	137	13	73	42
1965	1	1	14	12	23	20
1966	2	15	27	17	37	34
1967	1	2	3	4	32	14
1968	6	18	109	28	91	23
1969	2	4	11	6		
1970	6	1				

Table 2

Average catch (number of specimens) of the young cod of 3 years aged per one hour-trawling in Division 3K (fish-counting trawl)

Year class	Number of 3 year olds per one hour-trawling
1959	21
1960	11
1961	20
1962	15
1963	36
1964	8
1965	15
1966	27
1967	32
1968	40

Table 3

Water temperature in the 0-200 m layer (between 42°40'N,50°15'W and 42°55'N,50°15'W) on the southern slope of the Grand Bank of Newfoundland

Year	Month, date	Temperature (°C)
I958	May, 25-26	3,78
I959	May, 28-29	I,I0
I960	June, I9-20	I,28
I96I	May, 26-27	I,52
I962	May, 24	0,88
I963	May, I5-I6	0,99
I966	June, I3	2,77
I967	May, 7-I3	2,70
I969	May 24-25	3,47

Table 4

Average catch (number of specimens) of the young haddock at the age of 1 and 2 years per one hour-trawling (fish-counting trawl) in Division 3P

Year class	1 year	2 years
I964		55
I965	I3	4I
I966	II0	I9I
I967	I83	I6
I968	25	I0
I969	35	38
I970	32	

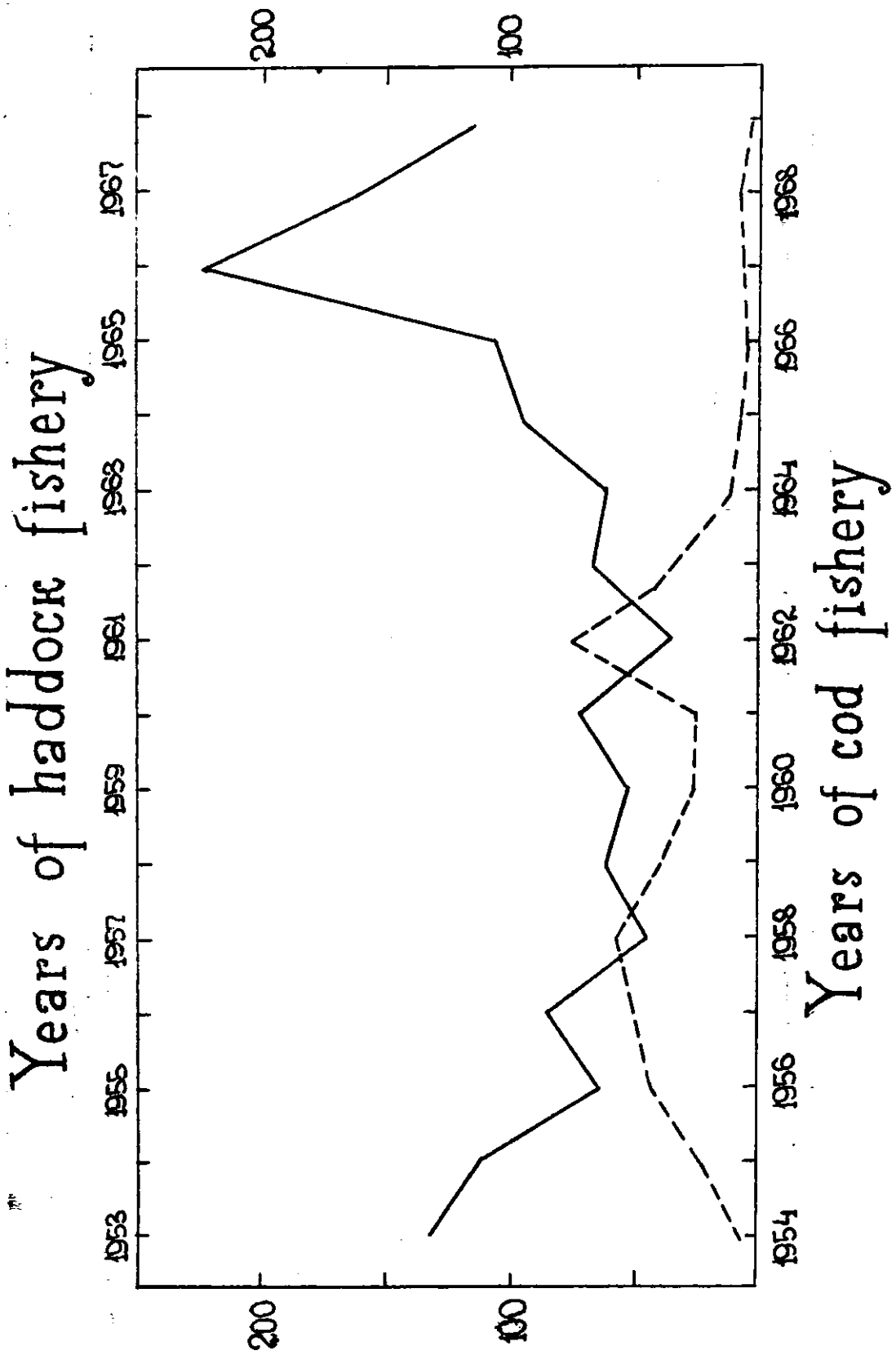


Fig.1. Fishery areas of cod (I) and haddock (2) in the Northwest Atlantic.

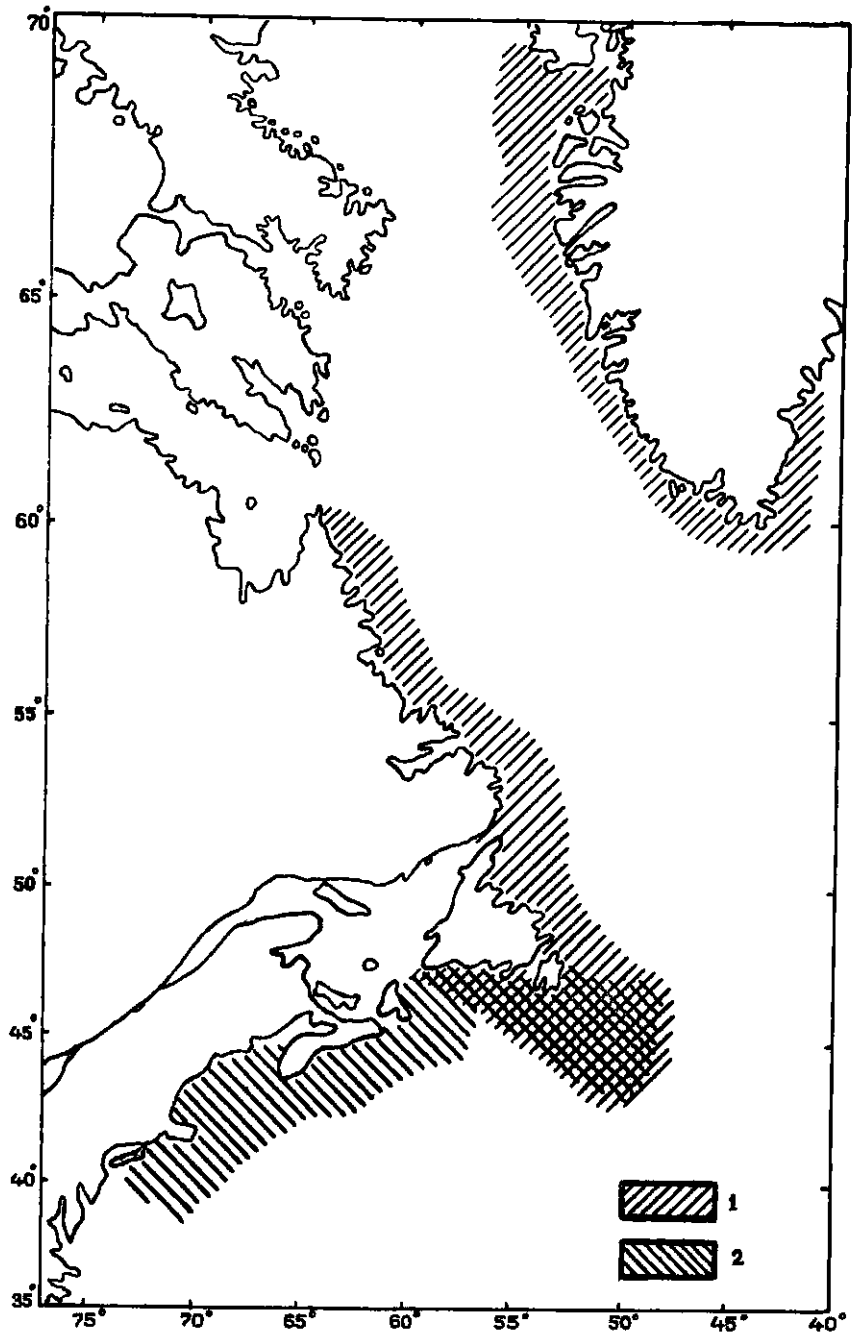
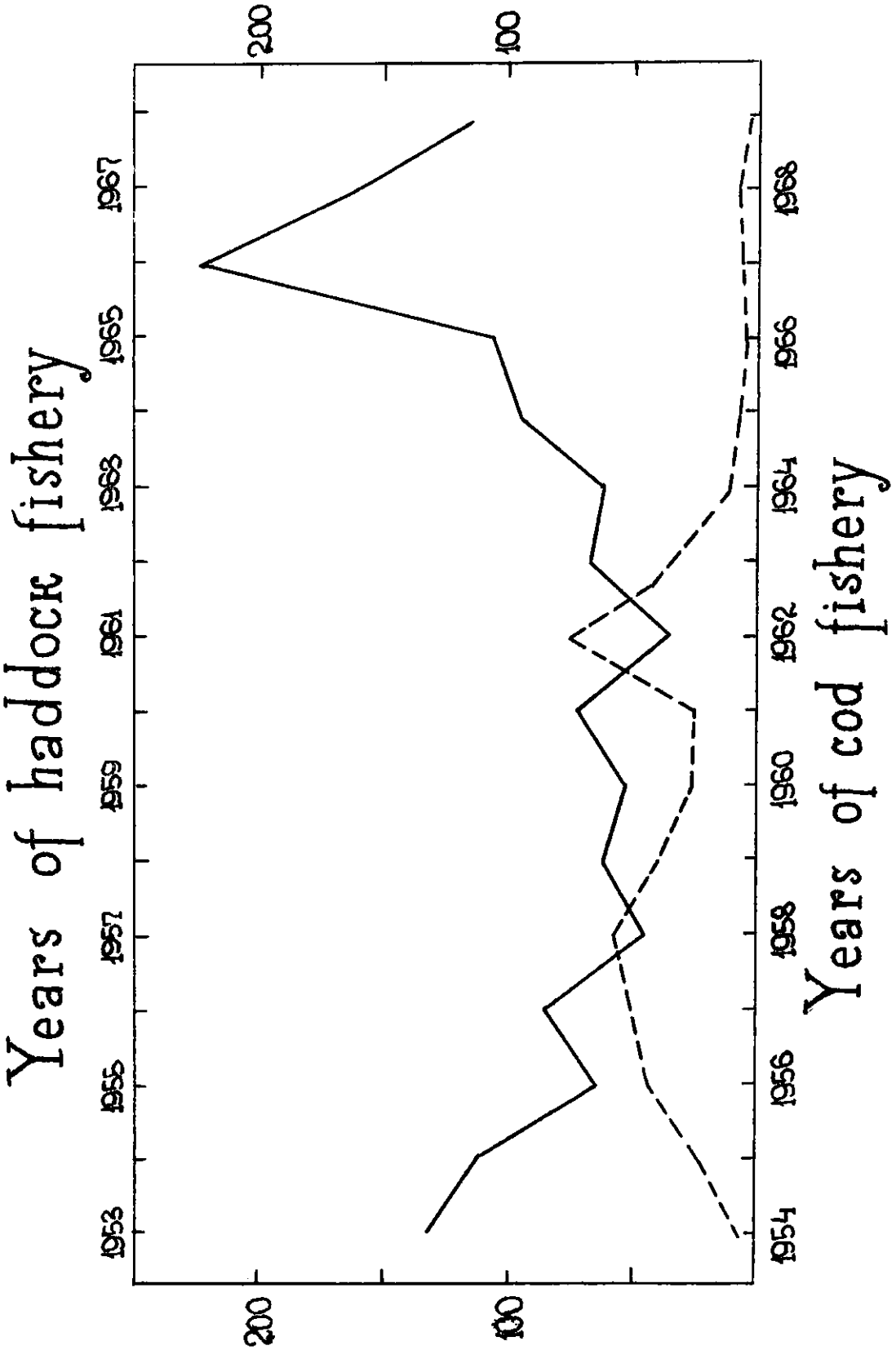


Fig.2. Annual catches of cod (solid line) and haddock (dotted line) in Division 3NO.



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