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On the effects of temperature on sole recruitment.

by

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INTRODUCTION

The situation of the sole fishery may be considered as critical to such an extent that the importance of reliable forecasts will be more and more prominent in the near future. As those forecasts however are generally based on the density and the composition of the parent stock combined with the fishing effort, they are neglecting the strengths of the incoming year-classes. Taking into account that first of all about two years elapse between the spawning and the recruitment to the fishery and secondly that the production rate is known to be very irregular year by year, it becomes clear that the forecasts only based on the parent stock can be biased. The crisis in the North Sea population as well as the biologists' demand for the conservation of the rather prosperous condition of other sole populations was reflected viz. in the proposed catch quota (ICES, 1973). It is self-evident that the strength of the incoming recruits will influence considerably these quotas based on forecasts on the parent stock. For this reason the study on the causes leading to a succes or a failure of a new year-class has to be intensified.

The temperature was considered by De Veen (1965) as being the most important factor for the year-class strength, although other unknown factors may also be of importance. His hypothesis was based on sole data in the North Sea. The aim of this study is to test the relationship temperature-breeding on other sole grounds, i.e.

the Irish Sea, the Bristol Channel and the English Channel.

MATERIAL AND METHODS

Due to the lack of sufficient international data the Belgian age distribution of the sole catches in the Irish Sea, the Bristol Channel and the English Channel for the years 1971, 1972 and 1973 were used. The mean number per 100 hours fishing was calculated for each year-class on the data compiled during the period 1971-1973. The numbers per hours fishing may be used as a standard because no substantial changes occurred in the Belgian fishing effort in the period under review.

The values thus obtained were transferred into a logarithmic scale and were plotted against the corresponding year. The results are given in the figures 1-3. The regression was calculated as well as the confidence belts with the probability of 95 %. From the distance of each value to the regression line the year-class strength was defined on the following semi-quantitative scale :

Poor : position in the lower area of the confidence belts.
Moderate : position between the confidence belts.
Good : position in the upper area of the confidence belts.
Strong : position in the upper area of the confidence belts, but extremely distant from the regression line.

The surface temperatures used in this study are taken from the ICES oceanographic data lists and Annales Biologiques.

RESULTS

A previous study (De Clerck, 1973) has indicated the marked differences between the sole population in the Irish Sea and in the Bristol Channel. These differences are mainly expressed in the growth rate. The third sole stock, viz. the English Channel stock which will also be considered in this study, can also be treated as different because of its proper growth parameters (L_{∞} = 33,3 cm, K = 0,33, t_o = 1,75 for the

males and L_∞ = 38,3 cm, K = 0,57, t_o = -0.39 for the females)

1. The year-class strength in the Irish Sea, the Bristol Channel and the English Channel.

From the position of the mean number/100 h.f. per year-class in the figures 1-3 the relative year-class strength was semi-quantitatively determined. These figures indicate great variations in and between the areas and considerable fluctuations from year to year.

During the period 1946-1969 the following classification of the year-class strengths can be made : for the Irish Sea : 7 poor, 10 moderate and 7 good ; for the Bristol Channel : 8 poor, 12 moderate and 4 good ; for the English Channel : 10 poor, 10 moderate ; 3 good and 1 strong.

There seems to be no relationship between the strength of the year-classes and the areas, e.g. during 1957 and 1963 the strengths per area were very much divergent.

Another phenomenon is the fact that the quantitative differences between poor, moderate and good year-classes in the Bristol Channel and Irish Sea are very limited. This is also reflected in the high correlation ($r = 0.97$ in the Bristol Channel and $r = 0.95$ in the Irish Sea). In the English Channel the numbers per year-class show great fluctuations ($r = 0.76$).

2. The relation year-class strength-temperature.

The strength of the year-classes was tested with the corresponding temperatures before and during the spawning of each year. This relationship is shown in figure 4. The correlation was calculated for the months January, February, March, April and May separarely and for the sum of the temperatures from January to May in order to obtain a global view.

These calculations lead to the following table :

Area	Correlation	Highest cor. during	Lowest cor. during	Cor. period Jan.-May
Irish Sea	positive	Feb. (0.43) Ma. (0.44)	May (0.14)	0.42
Bristol Ch.	pos./neg.	-	-	0.04
English Ch.	negative	Jan.(-0.32) Feb.(-0.39)	Apr.(-0.14)	-0.27

As appears from this table and from figure 4 the influence of the temperature before and during spawning is quite opposite according to the area.

In the Irish Sea there is a strong tendency that good year-classes are related to higher temperatures. In this respect the most striking figure is the poor 1963 year-class born during the severest winter of the period 1946-1969, with a February temperature of 1.4° C, whereas all the good year-classes are achieved at high January-February temperatures (about 6° C).

The data of the Bristol Channel where the yearly anomalies are rather small show no correlation at all. It was already pointed out in the first part of this study that the recruitment in the Bristol Channel area has nearly the same level every year. This must be due to the very stable mean temperatures during the months January to May (respectively 10.6 °C, 10.0 °C, 9.8 °C, 10,2 °C and 11,4 °C) whereas the absolute minimum was 8.7 °C and the absolute maximum 12.8 °C. No changes is temperature reflected by no changes in year-class strengths might in a certain respect also be considered as an argument in favour of De Veen's hypothesis.

On the other hand the English Channel population follows very good De Veen's hypothesis for the North Sea stock. Although the February temperature of 5.4 °C e.g. during 1963 was not so low as was the case in the Irish Sea (2,1 °C) it resulted never-

theless in a strong English Channel year-class in contrast with the poor 1963 recruitment in the Irish Sea.

DISCUSSION

Considering the results of the English Channel as well as the De Veen's results in the North Sea, there is a strong tendency to believe that there is a relationship between the temperature before spawning and the strength of the corresponding year-class, in the way that good and strong year-classes coincide with low water temperatures. The Irish Sea data give also arguments to this relationship, but in a adverse sence (good year-classes coinciding with high water temperatures). Finally, the sole in the Bristol Channel lives in a very regular water temperature system resulting in a permanent breeding amount nearly without ups and downs.

This study provided consequently further arguments in favour of the water temperature hypothesis but in view of the fact that some contrasts occur according to the area the relationship during the larval phase with predators and (or) competitors (also influenced by the water temperature) may be seriously interfering.

BIBLIOGRAPHY

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De Veen, J. (1968) On the strength of year-classes in sole. ICES, C.M. 1965 Near Northern Seas Committee No 62.

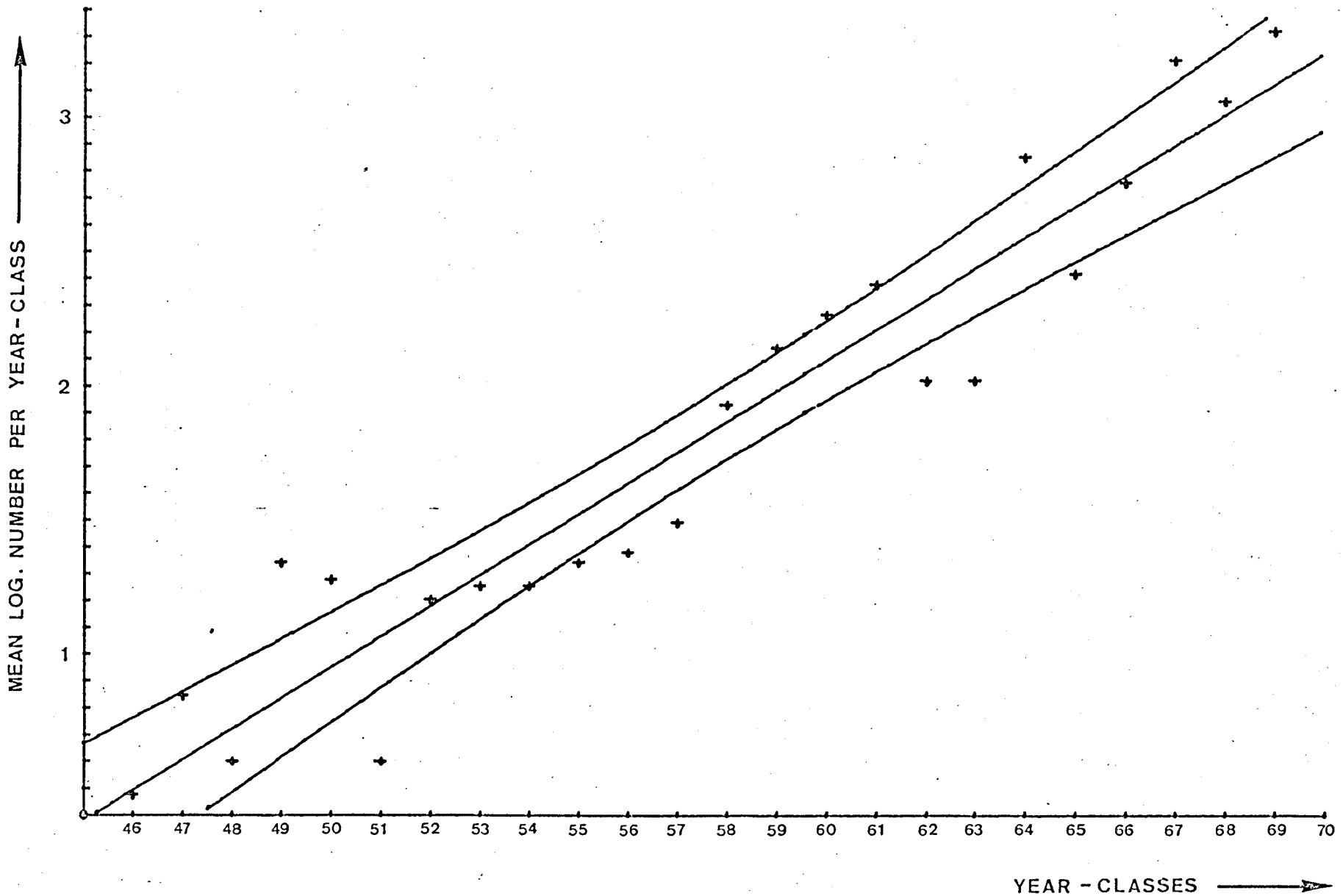

Figure 1 - The year-class strengths in the Irish Sea sole stock during the period 1946-1969.

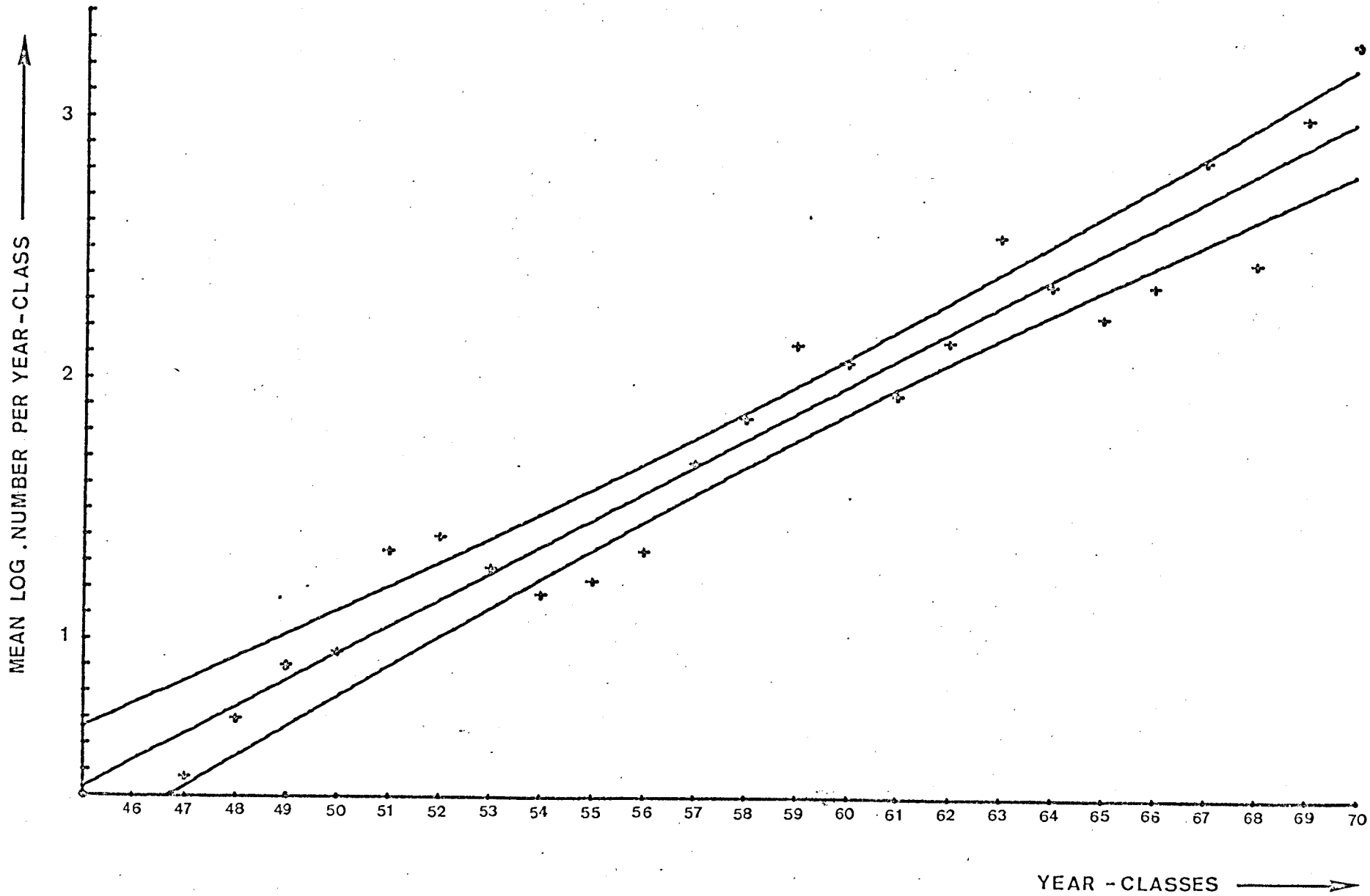

Figure 2 - The year-class strengthsin the Bristol Channel sole stock during the period 1946-1969.

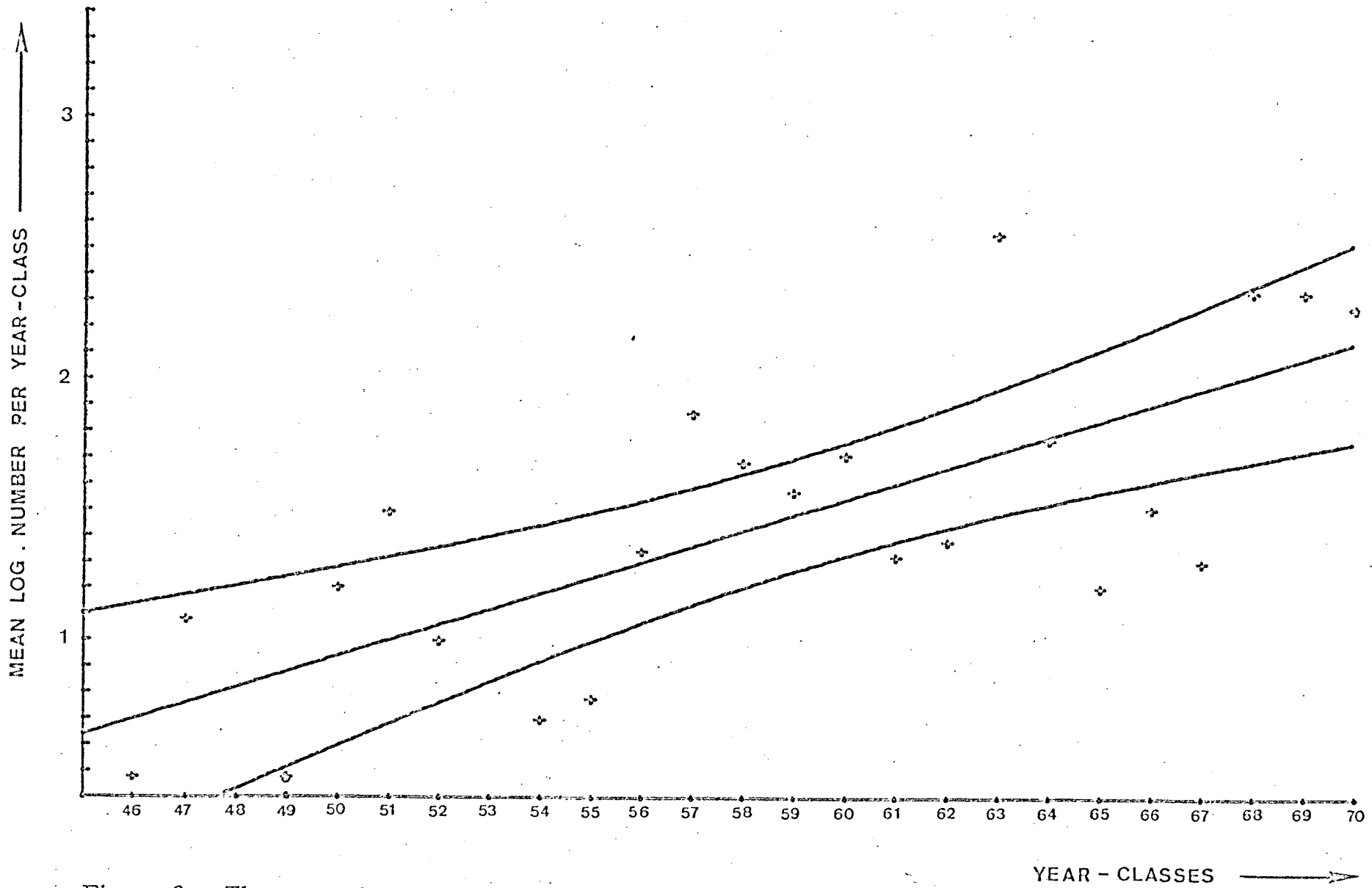

Figure 3 - The year-class strengths in the English Channel sole stock during the period 1946-1969.

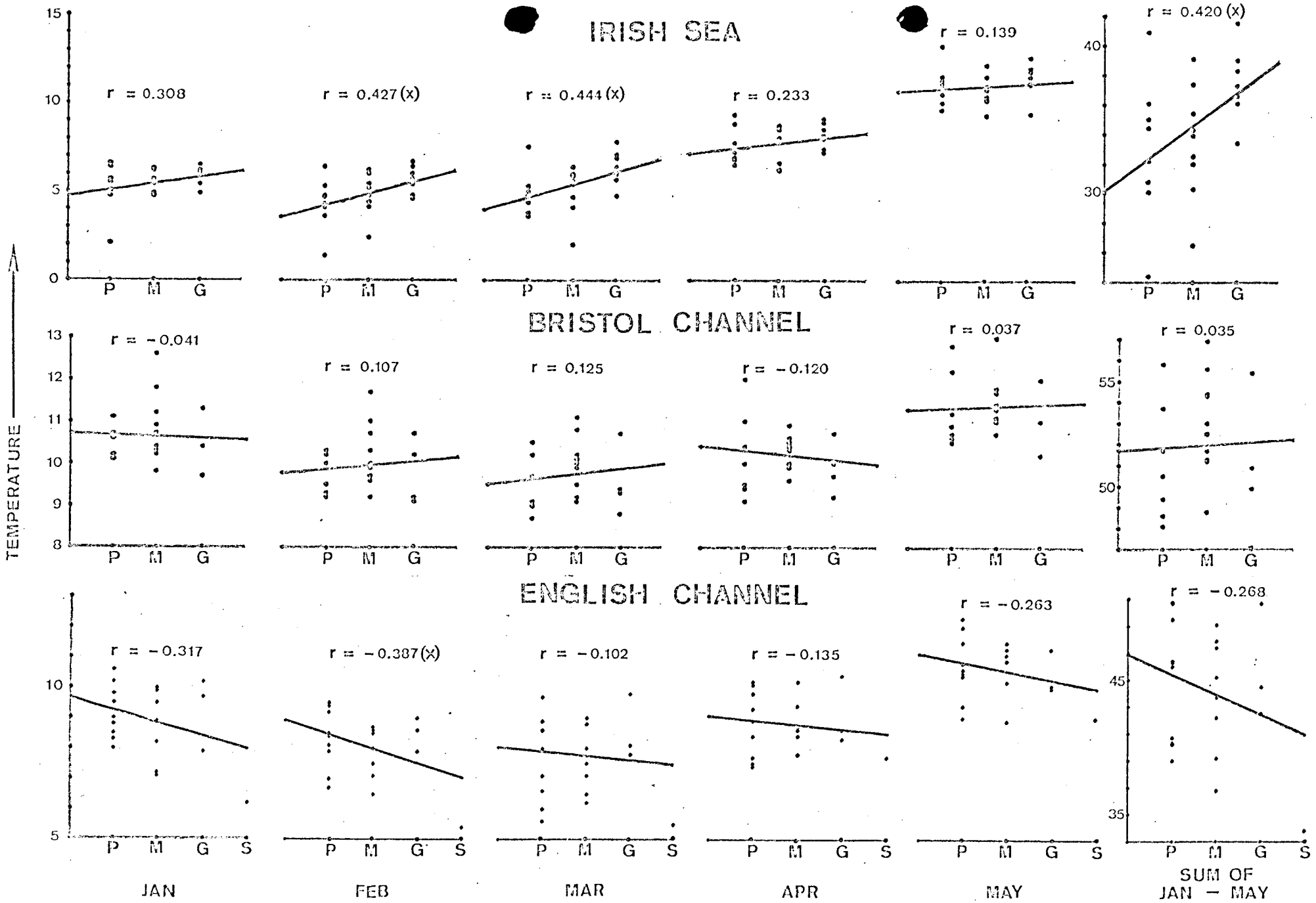

Figure 4 - The relationship between the strength of the year-classes and the temperature in the Irish Sea, Bristol Channel and English Channel.

(x) Significance 95 % probability