STOCK-RECRUITMENT RELATIONSHIP IN THE ADRIATIC SARDINE

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The stock-recruitment relationship in sardine was analysed, basing on the known biomass changes.

A partir des changements connus de la biomasse, on a calculé le rapport entre le stock et le recrutement de la sardine en Adriatique.

Recruitment of fish population can be estimated in different ways, mainly from tagging data, or by cohort and virtual population analysis or by simple monitoring of recruit numbers or biomass. In this paper we tried to estimate recruitment of Adriatic sardine from the data on the biomass of the spawning stock obtained from egg surveys (P i c c i n e t i, et al., 1980; R e g n e r, et al., 1983). The lower 95% significance limits of the estimated sardine biomass were as follows:

Year	Biomass (tons)
1978/79	218 253
1979/80	343 743
1980/81	500 943
1981/82	423 651

The rate of the biomass change, which includes both the recruitment and mortality of the stock can be estimated by the equation:

$$\Delta B = B_{t_{i+1}} - B_{t_i} \qquad (1),$$

where $B_{t_{i+1}}$ is the biomass in the defined year, while B_{t_i} is the biomass in the year before. If the stock decreases ΔB is negative.

From this equation the ammount of recruits can be estimated using the equation:

$$R_j = B_{t_{j+1}} - \{\sum_{i=1}^{c} (B_{c_{t_{ij}}} + G_{c_{t_{ij}}}) e^{-Z}\} \qquad (2),$$

where Rj are the recruits, $B_{t_{j+1}}$ is the biomass equal to $B_{t_{i+1}}$ from the equation (1), while B_{t_i} from the same equation is substituted by the sums

of the every age class ($B_{c_{t_{ij}}}$) to which the growth increment during one year ($G_{c_{t_{ij}}}$) is added.

These sums are corrected for a year mortality (e^{-Z}). Boundary condition for equation (2) is that recruitment (R) cannot be negative, which implies that total mortality coefficient (Z) is density-dependent.

The growth in length and total mortality coefficients were estimated from the data on sardine in the central Adriatic (M u ž i n i ć, 1954), and following relations were obtained:

$$l_t = 201 \left[1-e^{-0.29(t+2.11)}\right] \qquad (3),$$

whereas the comparison of the sardine catch and their total mortality shows that Z is density-dependent, and that it can be estimated from the linear equation:

$$Z_i = 0.000034\ U_i - 0.129277 \qquad (4),$$

where U_i is the catch of sardine from the i-th year.

The length-weight relationship in sardine, according to A l e g r i a - H e r n a n d e z (1983), is

$$W_t = 0.0000259\ l_t^{2.757} \qquad (5).$$

From the equations (3) and (5) it was estimated that the length and weight of the first maturity of sardine in the Adriatic were l_{tR} = 125 mm and W_{tR} = 15.65 g respectively. The age of the first maturity was estimated to be t_R = 1.24 years.

By substituting values obtained from equations (3), (4), and (5) in the equation (2) the following estimates of sardine recruitment were obtained:

Year	Individuals	R Tons
1979	$6.407.10^9$	100271
1980	$1.093 \cdot 10^{10}$	170989
1981	$1.478 \cdot 10^{10}$	231282
1982	$1.031 \cdot 10^{10}$	161425

The relationship between the biomass of spawners (S) and biomass of recruits (R) was found to be:

S	R
(1979) 218253	(1980) 170989
(1980) 343743	(1981) 231282
(1981) 500943	(1982) 161425

Although only four years of biomass estimates were available, we

tried to fit the data obtained on S and R in the stock-recruitment model of R i c k e r (1954):

$$R = ASe^{-bS} \qquad (6),$$

where R and S are recruit and spawner biomass respectively, while A and b are the constants.

Fitting the spawning stock and recruit data to R i c k e r's model (Fig. 1) the following parameters were obtained:

$$R = 1.7248191 \cdot Se^{-0.0000032\ S},$$

with the high coefficient of correlation:

$$r = -0.9559$$

Thus, although the data on sardine biomass are scarce, it seems that stock-recruitment relationship might be approximated by R i c k e r's model.

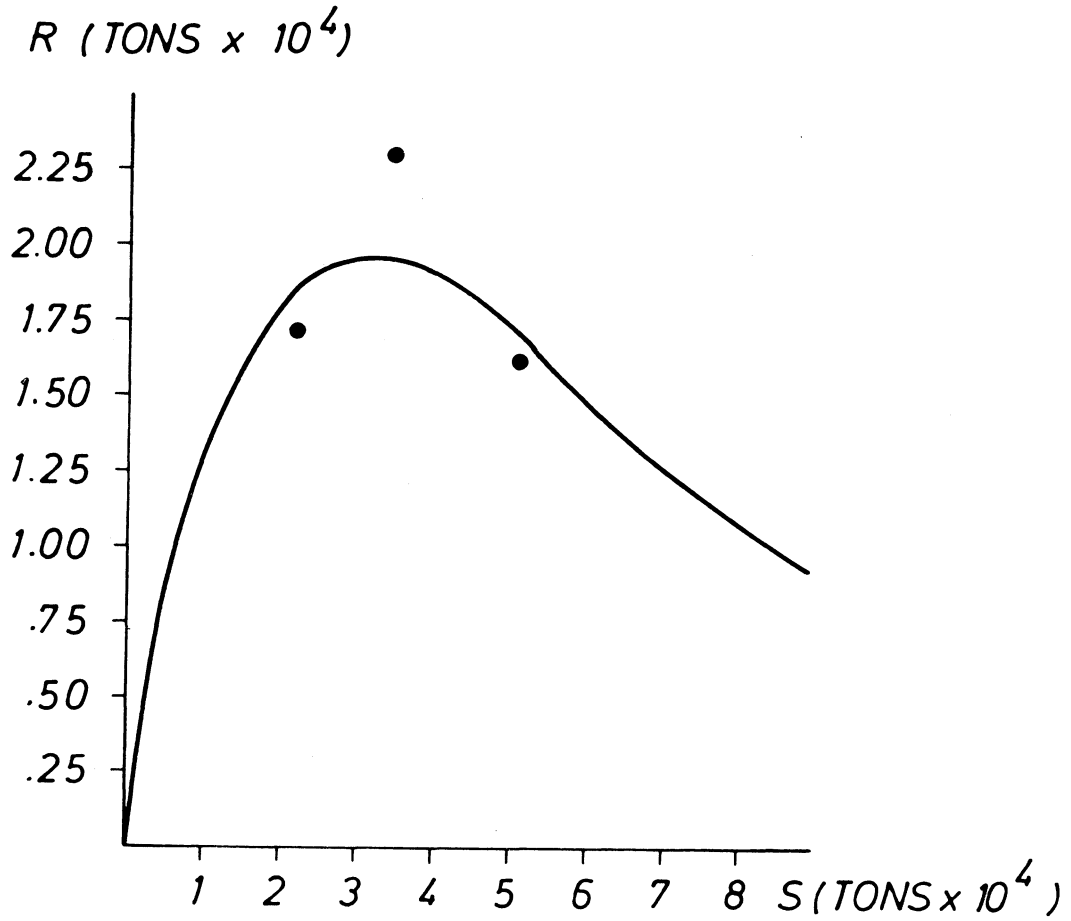

Fig. 1. The Ricker's curve of the stock-recruitment relationship in sardine.

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