

Biotic and abiotic factors influencing sardine, *Sardina pilchardus* (Walb.) abundance in the Croatian part of the Eastern Adriatic

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Abstract

Long-term variations in *Sardina pilchardus* catch per unit effort in relation to primary production, temperature, salinity and oxygen are given. Data were sampled from the Eastern Adriatic Sea from 1965-1988.

1. Introduction

Sardine, *Sardina pilchardus* is the most abundant and commercially most important fish species caught in the Croatian part of the Eastern Adriatic. Its population size and catches fluctuate greatly from year to year. Population size variations may be due to the impact of different factors on the sardine life cycle, particularly during the early developing stages up to the recruitment.

This paper deals with the long-term variations in catch per unit effort (CPUE - indicator of abundance in the exploited fish population) for the 1965-1988 period in relation to primary production, temperature, salinity and oxygen content. They were analysed in the principal fishing grounds of the Eastern part of the Adriatic Sea.

2. Material and Methods

Sardine length data as well as data on sardine catches and fishing effort were taken from the principal Croatian fishing grounds (Figure 1). Hydrographic data were collected by Physiographic laboratory of the Institute of Oceanography and Fisheries, Split, as well as published data (Buljan and Zore-Armanda, 1979; Zore-Armanda *et al.*, 1991). Means of the amounts measured between depths of 50 and 150 m were calculated. Annual mean temperature, salinity and oxygen concentrations data were used in these considerations. Data on primary production were collected from the same area by the IOF Laboratory for Phytoplankton.

Assuming that above factors could have an effect throughout the life span of sardine, from hatching up to entering into the exploitation phase, mean catch per unit effort was correlated

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to the annual mean values of hydrographic parameters and primary production with lags of two, three and four years.

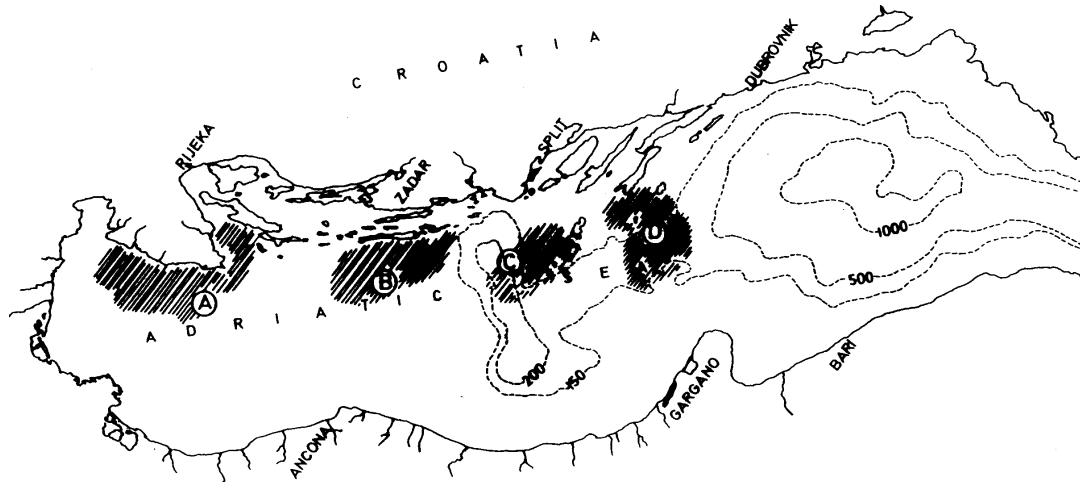


Figure 1. Map showing the principal Croatian fishing grounds - A: the North Adriatic, B: Dugi Otok , C: Svetac-Jabuka and D: Sušac-Palagruža.

3. Results and Discussion

The sardine is the target pelagic fish species in the Croatian part of the Eastern Adriatic. Its total catches, as well as catch per unit effort, varied considerably showing the identical variation trend (Figure 2). It is evident that amounts of the total annual sardine catches and MSY are very similar.

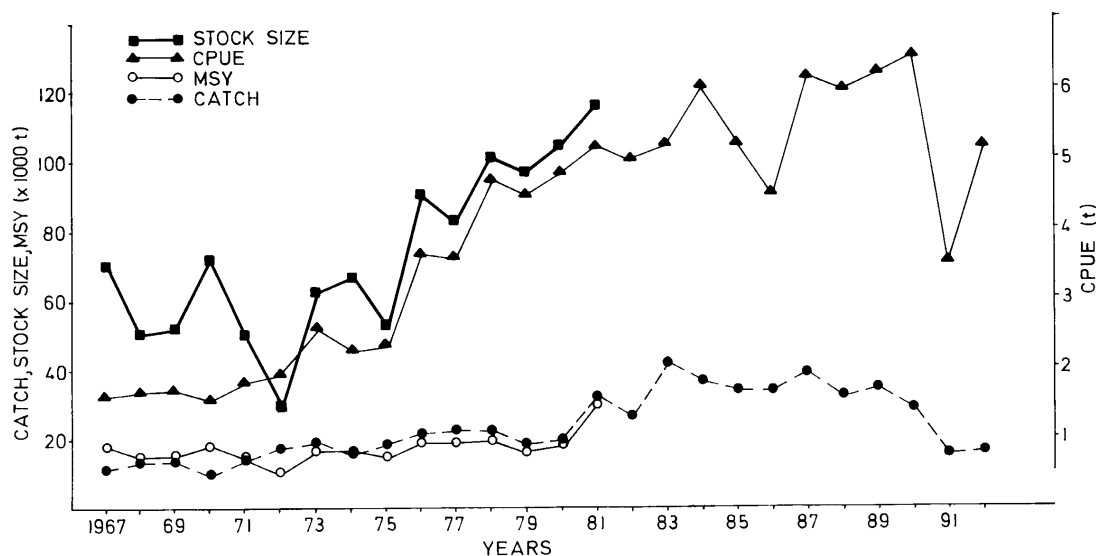


Figure 2. Variations in sardine stock size, as well as sardine total catch, catch per unit effort (catch/boat/fishing day) and amount of MSY from the Croatian part of the Eastern Adriatic.

Seasonal variations of catch per unit effort (catch/boat/fishing day) in the principal fishing grounds is evident as well, especially during Autumn and Winter (Figure 3); Autumn and Winter are the prematuration and spawning period of this species (Mužinić, 1979; Sinovčić, 1983).

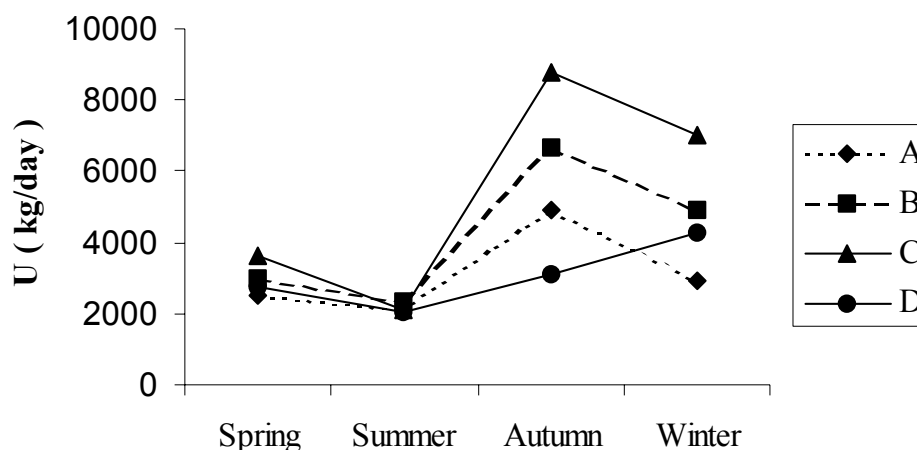


Figure 3. Seasonal variations of catch of unit effort (catch/boat/fishing day) during the 1979-1990 period in the main Croatian fishing grounds- A: the North Adriatic, B: Dugi Otok, C: Svetac-Jabuka and D: Sušac-Palagruža.

In the study area the sardine schools are located mainly between 50 and 150 m. Besides, sardine spawn at 60-150 m depth. According to the sardine catch per unit effort (catch/boat/fishing day), the sardine population showed a trend towards continuous increase during the period of investigation, with fluctuations which may be indicative of the year classes' strength (Sinovčić and Alegria, 1997). Variations in population increase and vulnerability depend on the effects of different physiological changes and environmental factors affecting consecutive stages of fish life, particularly during spawning and early developmental stages, when high larval mortality occurs. Catch per unit effort for the sardine was significantly correlated to mean primary production (Figure 4). The correlation is strong if a three-year lag between sardine CPUE and mean primary production is taken into consideration. Changes in population abundance in successive years have been related to variations in hydrographic conditions (Table 1).

Table 1. Correlation coefficient between CPUE (catch/boat/fishing day) and different values of primary production and some abiotic factors (temperature, salinity, oxygen content) from the main Croatian fishing grounds in the 1965-1988 period.

FACTORS	A	B	C	D
Primary production	0.796*	0.697*	0.881*	0.896*
Water temperature	-0.368*	-0.595*	-0.558*	-0.716*
Salinity	0.150	0.262	0.409*	0.264
Oxygen content	-0.062	-0.040	-0.186	-0.103

*significant ($p < 0.05$)

A: value at the year of $n - 3$; (n is the years when CPUE was estimated);

B: value at the year of $n - 4$

C: mean of the years n , ($n - 1$) and $n - 2$

D: mean of the years n , ($n - 1$), ($n - 2$) and ($n - 3$)

It is believed that the effects of hydrological parameters in certain years reflect upon the catch per unit effort, as an indicator of sardine population abundance, with a lag of two to three years. It is the period in which the whole sardine population is sexually matured (Sinovčić, 1984).

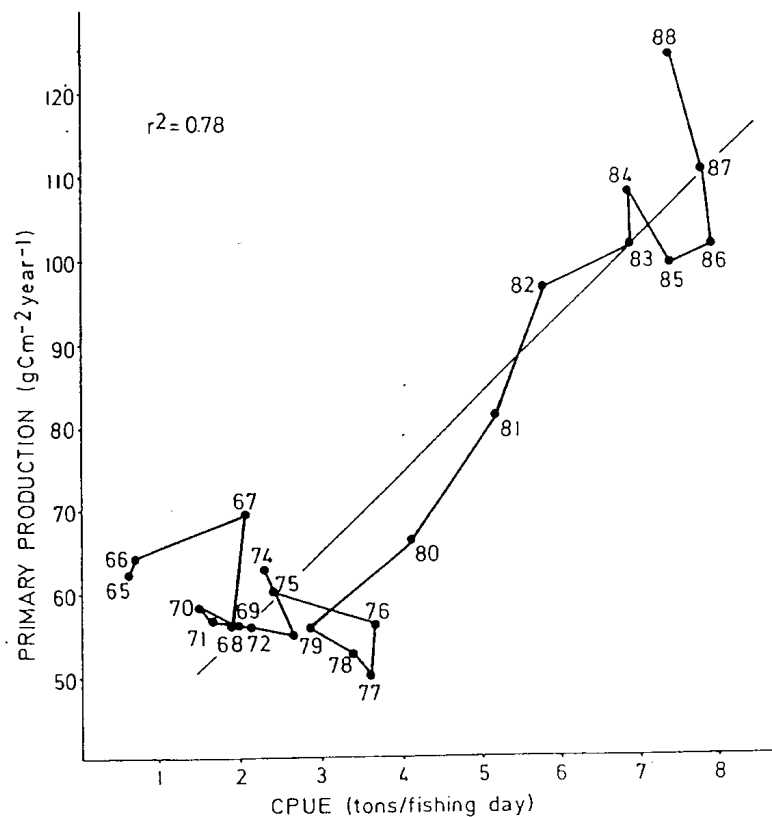


Figure 4. Relationship between sardine catch per unit effort (catch/boat/fishing day) and mean primary production in the Middle Adriatic from 1965 to 1988. Primary production mean in years: $[n + (n - 1) + (n - 2)]/3$.

The correlation between mean temperature and CPUE is negative and significant; the best and most significant correlation was obtained for three-year intervals. The correlation between temperature and CPUE was calculated for all three years and for a four-year period (Figure 5). Results show significant correlation, particularly for the four-year period (Table 1).

The correlation between sea water salinity and CPUE is positive to a certain extent, but not significant. The only exception is the three-year mean salinity (Table 1). This correlation probably refers to the beginning of the first maturation of sardine gonads.

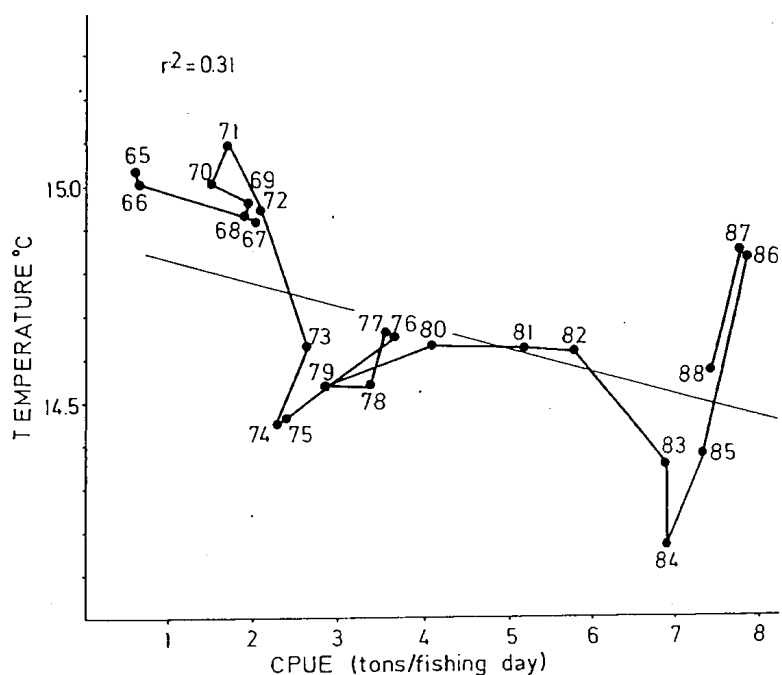


Fig 5. Relationship between sardine catch per unit effort (catch/boat/fishing day) and mean sea water temperature in the Middle Adriatic from 1965 to 1988. Temperature mean in years: $[n + (n - 1) + (n - 2)] / 3$.

The data available did not offer any reliable conclusion as to the actual impact of oxygen concentration on catch per unit effort fluctuations or on sardine population abundance (Table 1).

4. References

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