

DAILY EGG PRODUCTION METHOD FOR SPAWNING BIOMASS ESTIMATES OF SARDINE IN THE SOUTH-WESTERN ADRIATIC SEA

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Abstract

In the month of November 1994, an Egg Production Method Cruise was carried out, aiming at the evaluation of the spawning biomass of the sardine (*Sardina pilchardus* Walb.) along the coasts of Apulia in the lower Adriatic. The results of the egg production and of the biological parameters relative to the adult population, are compared to those of other Mediterranean areas. The D.E.P.M. applied in November 1994 estimated a spawning stock biomass of 14,196 metric tons (CV = 0.144) for the South-Western Adriatic sardine population. The D.E.P.M. experimental research shows a sardine biomass evaluation 7.69 times smaller than the one reckoned with the egg and larva method.

Key-words: Fishes, biomass, spawning, Adriatic Sea

Introduction

So far two evaluation methods have been employed in the Apulian coasts to estimate the biomass of Clupeiforms: acoustic, or "echo-survey" campaigns, from 1976; "eggs and larvae", from 1984. In 1994, within the biological resources small pelagic fish program, the Ministry of Agriculture Food and Forest Resources recommended the introduction of the D.E.P.M. (1) to be followed side by side with the traditional methodology. The present research is the first applying the D.E.P.M. on *S. pilchardus* in the waters of the lower Adriatic. Before now the D.E.P.M. was applied on European sardine by Pérez *et al.*, (2) (North Atlantic Spanish coasts).

This methodology is based on the following model:

$$B = \frac{KPoAW}{RFS}$$

where B = spawning biomass in metric tons, P_o = daily egg production (number of eggs per sampling unit, m^2 per day), A = total survey area (in m^2 per sampling units), W = average weight of mature females (grams), R = sex ratio (fraction of mature females by weight), F = batch fecundity (average number of eggs per spawning per mature female), S = fraction of mature females spawning per day, k = conversion factor from grams to metric tons. Egg surveys and adult surveys (3) were obtained as part of the campaigns carried out contemporaneously during the peak spawning season.

Material and methods

The survey was carried out from 4 to 29 November 1994, the period of the highest spawning intensity for *S. pilchardus*, covering three quarters of the reproduction area in the western zone of the lower Adriatic sea. Both the egg surveys and adult surveys were carried out using chartered research ships equipped with midwater otter trawls. In order to catch more adult samples were additionally used commercial vessels equipped with flying midwater pair trawls and purse seine. The sampling and data processing methods as regards the egg and adult campaigns have been described by Casavola and Rizzi (4) and Casavola *et al.*, (5, 6). The plankton samples were collected by means of a CALVET net (335 m mesh), raised vertically from a depth, when possible, of 100 m, covering a sea surface of 14,790 km^2 . In the area surveyed samples were taken in 88 stations (Fig. 1) at a distance of 7 NM each, along 23 transects also at a distance of 7 NM, angled at 45°. These latter continued until, examining the plankton collected, sardine eggs could be found (Fig. 2), and above all knowing, on the basis of many years' experience (from 1984) in the egg-larva method research, the limits of the spawning grounds (7). The temperature and salinity profiles were recorded in the same stations by means of a multiparameter probe.

In the laboratory the eggs of *S. pilchardus* were counted and staged according to the degree of embryonic growth, as described by Gamulin and Hure (8); the eggs were classified according to age and to the relationship between the degree of egg development and water temperature. Then, using again manual procedures, the stages of sardine eggs in each station were grouped into "spawning nights" (5) and eggs' ages were recalculated on the basis of the time that passed between 20.00 (GMT) (highest spawning time assigned by the authors) and the eggs collecting time.

The whole area surveyed, with the purpose of reducing the variance, was post-stratified, following the Picquelle and Stauffer (9) procedures, into two strata: stratum 0 (egg production = 0) and stratum 1 (positive stations). The data processing referring to the positive stratum, obtained using a weighted nonlinear least squares regression

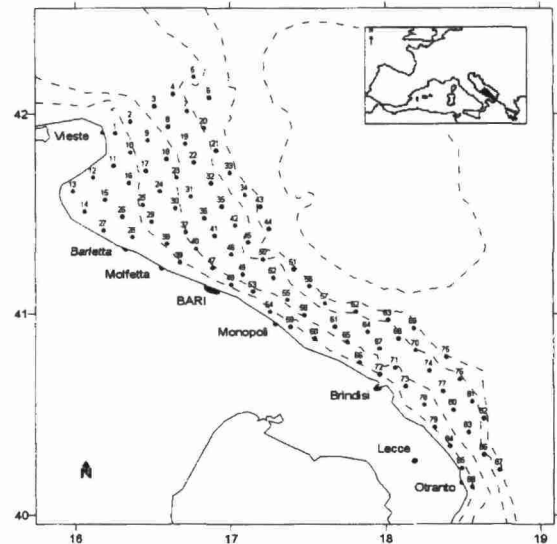


Fig. 1 - D.E.P.M. *Sardina pilchardus* egg survey.

(10), allowed to define a mortality curve (Fig. 3), using the classic model $P_{(t)} = P_o x e^{-zt}$, where t = age in days measured as the time elapsed from spawning to the time of sampling, $P_{(t)}$ = number of eggs per m^2 in age category t , P_o = daily egg production per sampling unit (m^2), z = daily rate of instantaneous mortality.

52 samplings were carried out on board the ships (Fig. 4), and only in 46 cases sardines could be caught. As the number of sampled individuals per trawls was not always the same, the parameters referring

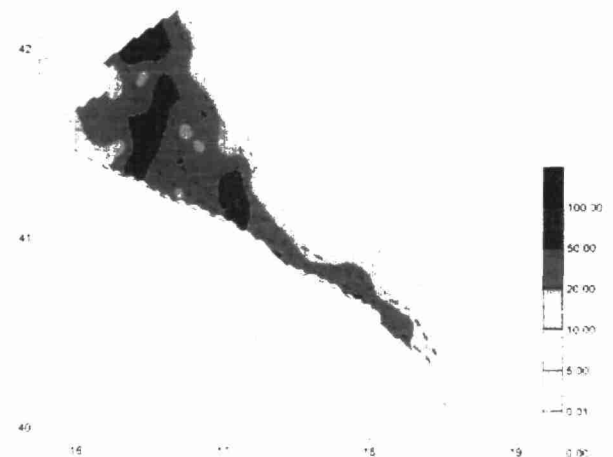


Fig. 2. Distribution and abundance of *Sardina pilchardus* eggs (No/ m^2) during the November 1994 survey in the lower Adriatic Sea.