ANCHOVY BIOMASS ESTIMATE BY THE DAILY EGG PRODUCTION METHOD IN THE SOUTH-WESTERN ADRIATIC DURING 1999

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The Daily Egg Production Method (D.E.P.M.) is applied to estimate the spawning biomass. It was developed in the 80s by the USA National Marine Fisheries to estimate the small pelagic biomass. Both the method and its applications are widely described in the NOAA Technical Report NMFS 36 text (1).The biomass estimate is based on the following equation:

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

where B = the spawning biomass in metric tons, P_o = the 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 mature female), S = fraction of mature females spawning per day, k = conversion factor from grams to metric tons.

This survey has been carried out within the program "Estimation of the Mediterranean anchovy (*Engraulis encrasicolus L.*) biomass by the daily egg production method in Tracian Sea (Greece) and South Western Adriatic Sea (Italy)", contract n. 98/040, financed by the EEC, in the Lower Adriatic Sea.

The survey was carried out between 30 August and 18 September 1999, both during the day and at night, covering most of the reproductive zone in the eastern arc of the lower Adriatic. 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 has been described by Casavola (2, 3).

A total of 122 ichthyoplancton samples were collected by means of a CalVET net (0.250 mm mesh), raised vertically from a depth, when possible, of 100 m, covering a sea surface of 12,862 km^2. The egg sampling procedure was based on a 5 nautical mile path (stations and transepts), with 20 transepts. In the laboratory, teleost eggs were separated in plankton samples caught in a CalVET net and fixed in 4% formalin . Anchovy eggs were then counted and staged according to the degree of embryonic development (4) in order to calculate mortality rates using specific software "Stageage" and "Eggreg" (5, 6), starting from the concentration of embryonic phases (divided by area) and water temperature at a depth of –20 mt., recorded in each sampling station. The elaboration of the data relative to the positive stratum, obtained using a weighted nonlinear least squares regression (7), has made it possible to define a mortality curve using the classic model, $P_{(t)} = P_{(0)} \times e^{-zt}$, where t = the age in days, $T_{(t)}$ = the number of eggs/0.05m^2 of age t, $P_{(0)}$ = daily egg production/0.05m^2, z = daily instantaneous death rate.

From a total of 43 trawls, 22 adult anchovies were sampled. The parameters relative to the adults (W, F, S and R), as the number of individuals sampled was not always equal in every trawl, were estimated by means of average weighted and variances using the equations of Picquelle and Stauffer (8). The average weight of females, W, was calculated as the average weight of mature females per haul, all females in the sample were active spawners. 1078 females were used in the estimate of this parameter. It was necessary to adjust the weight of females which were in the hydrated condition, due to the water retention during hydration, using the regression : W = -0,1343 + 1,0607 x W^* where W^*, is the ovary-free weight of females with no hydrated eggs.

The batch fecundity, F, was estimated using the regression between batch fecundity and weight (without ovaries, W_h^*), of 97 hydrated females, carefully chosen from among the 133 caught during the campaign. The weight of the hydrated females used ranged from 6.7 to 33.0 g, the length from 11.1 to 17 cm, with an average weight of 17.2 g and average length of 13.9 cm. The resulting linear regression is $F = 58.973 + 372.38 \times W_h^*$ ($R^2 = 0.79$).

The fraction of mature females spawning per day, (S), was determined by hystological analysis of post-ovulatory follicles (PO) classified in three age bands (9): day-0 PO = 0-8 hours, day-1 PO = 9-32 hours and day-2 PO = > 32 hours. The S, given that the day-0 PO females are oversampled, is expressed as a fraction of females with day-1 post-ovulatory follicles.

The relationship between the sexes, (R), was calculated as a proportion of the mature females by weight.

Table 1 shows the D.E.P.M. parameters and the estimated anchovy biomass. From 1994 to 1995, in the Lower Adriatic sea, there has been an increase of anchovy biomass from 8,129 metric tons to 14,307 (2, 3). In 1999 a value of 10.361 metric tons has been found, showing a reduction by 25% of the stock in these later years. The daily fecundity value of the population of *E. encrasicolus* observed in 1999 in the Southern Adriatic sea (20.17 egg/day g of spawner) is lower than that reported by García et al., (10) and Garcia and Palomera (11) (69.8: Catalan sea and the Gulf of Lions; 69.6: Ligurian and N. Tyrrhenian sea), and significantly lower than results obtained by Palomera and Pertierra (12) (100.1: Catalan sea). In the latter case, the higher values of daily fecundity in the anchovy population is due to higher values regarding both egg production of the sample and laying frequency. The daily mortality rate (0.65) is similar to the values reported by Palomera and Pertierra (12) for the Catalan sea (0.56) and it is, instead, lower than the value reported by Garcia et al., (10) for the Catalan sea and for the Gulf of Lions (1.09) and in the Ligurian sea and the N. Tyrrhenian (1.55).

Table I. - D.E.P.M. parameters estimate of *Engraulis encrasicolus* population from the Apulian Adriatic Sea; coefficient of variation in parentheses. Survey 30 August – 18 September 1999.

D.E.P.M. Parameters	
Po1	1.875 (0.23)
Po	0.812 (0.10)
z	0.648 (0.27)
A Stratum 0 (km^2)	7,288
A Stratum 1 (km^2)	5,574
W	16.97(0.039)
F	6,379 (0.039)
S	0.102 (0.098)
R	0.529 (0.042)
DEPM Biomass (MT)	10,361 (0.642)

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