DAILY EGG PRODUCTION METHOD FOR ESTIMATING SICILIAN CHANNEL ANCHOVY SPAWNING BIOMASS IN 1998 AND 1999

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Abstract

Daily Egg Production Method (DEPM) was carried out to estimate the spawning biomass of the Sicilian Channel anchovy (*Engraulis encrasicolus*) in 1998 and 1999. The spawning biomass suffered a drastic decline from 13224 TM in 1998 to 853 TM in 1999 evidenced by a great reduction of the positive stratum from 5329 to 769 km2, and the decrease of egg abundance over this stratum from 65.5 to 43.62 eggs/m2. The adult population, however, showed a greater reproductive potential in 1999; batch fecundity increased from 4835 to 5871 eggs/batch and spawning fraction from 0.14 to 0.17.

Key-words: Pelagic, Fishes, Spawning, Biomass, Sicilian Channel

Introduction

Since its first application to the mediterranean anchovy, *Engraulis encrasicolus*, of the Catalan Sea in 1990 (1), the DEPM has been used in the Mediterranean to evaluate the anchovy spawning biomass of the Catalan Sea, Gulf of Lions and Ligurian-North Tyrrhenian seas (2), North Aegean sea (3 and 4) and South-Western Adriatic sea (5). This communication presents the results of the DEPM spawning biomass estimates of the Sicilian Channel anchovy in 1998 and 1999 within the framework of the EU DG-XIV financed projects MED-96-052 and MED-98-070.

Material and methods

Egg surveys (Fig.1) were carried out between June 23-July 24 1998 (BANSIC-0698) and June 19-June 25 1999 (BANSIC-0699). Surveys were designed to include the full range of anchovy spawn following a 4x4 NM track basic stations scheme. Plankton sampling took place on a 24 hour-a-day basis, using a 25 cm diameter CalVET net (150μ mesh) retrieved vertically from a depth of 100 m at 1 m/s. Temperature and salinity with depth from CTD probe were obtained in each station. Plankton samples were analysed on board to observe the eggs presence/absence and fixed and conserved in at 5% buffered formalin. Adult surveys (Fig. 2) were combined spatially and temporally with egg surveys: ANCHEVA-0698 during June 19 to June 25 1998 and ANCHEVA-0699 between June 6-June 17 1999. Judgment sampling with a semi-pelagic trawl, according to echogram registers, was accomplished. Hauls ranged from 06:00 to 24:00 GMT intensified between 19:00 and 24:00 to collect hydrated females. Fifty randomly selected individuals per haul were sampled. When hydrated females appeared, extra sampling was done to obtain the highest possible number of these per length class. All the ovaries were fitted in buffered formaldehyde (4%) in the first two hours after death.The spawning biomass estimate is based on Stauffer and Picquelle's equation (6),

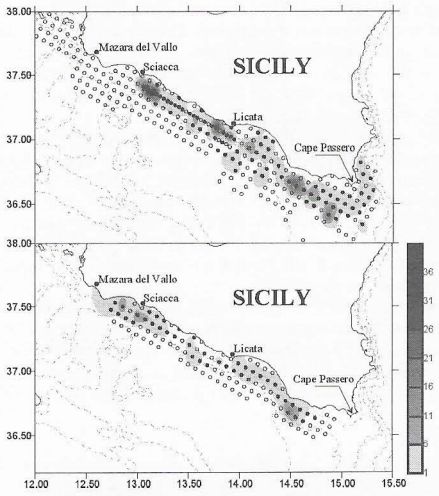

Figure 1. DEPM egg surveys showing anchovy egg distribution and abundance (eggs/0.1m2) interpoled by Kriging Method. (,) Positive stations. (+) Negative stations .

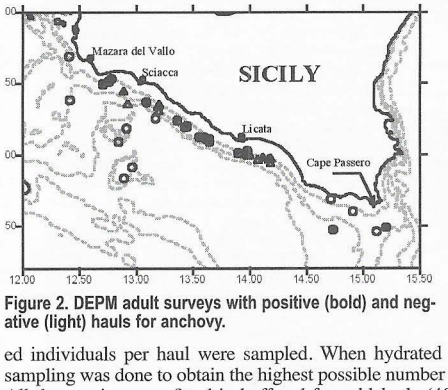

Figure 2. DEPM adult surveys with positive (bold) and negative (light) hauls for anchovy.

$$B = k \cdot A\,(P \cdot W) / (R \cdot F \cdot S)$$

where, B = spawning biomass (metric tons), k = conversion factor (grams to metric tons), P = daily egg production (eggs produced per sampling unit per day), A = total survey area (in sampling units), W = average mature females weight (grams), R = sex ratio (fraction in weight of mature females), F = batch fecundity (average number of eggs per mature female per spawn), and S = spawning fraction (fraction of mature females spawning per day). The variance of the biomass estimate was calculated through the delta method (7), as a function of variance and covariance of the estimates of parameters.The mean and variance of the egg and adult parameters were estimated following Picquelle and Stauffer's procedure (8). Its application for the Sicilian Channel anchovy has been described in (9) in great detail.

Results and discussion

Table 1 shows the collections gathered and the details from both the egg and adult surveys. The fitted linear models obtained to adjust observed weight for hydrated females and for the estimation of batch fecundity appear in Table 2. The DEPM parameters and the spawning biomass are summarised in Table 3. Spawning biomass suffered a substantial reduction from 1998 to 1999. This drastic decline is mainly attributed to a great decrease observed in egg abundance. The anchovy egg distribution area was more restricted and northward displaced in 1999. The positive stratum (A1) in 1999 only represented 14% of A1 in 1998. Moreover, although two of the three main spawning grounds found in 1998 remain (Sciacca and Scicli), they showed a great decrease in anchovy egg abundance (Fig. 1). Lower temperature found in 1999 could only explain partially this egg reduction since it involves longer time exposure to mortality by predation. But it can not account for the great variation observed and other biological and environmental factors must be involved. The estimates of P1 and Z reflect these changes, although the final stratified estimates of the daily egg production (P) are quite similar (Table I). In respect to the adult parameters, spawning frequency (based on the average number of day-1 and day-2 females) was 7.1 and 5.8 days in 1998 and 1999 respectively. The 1999 adult population showed higher reproductive potential since despite W was ±1g lower, F and S were greater.

Table 1. Collections gathered and details from egg and adult DEPM surveys.
+Stn, Positive egg stations; T^a, 10 m depth average T^a in ºC; A, in km2; +Trwl, Positive trawls for anchovy; +Hyd, Positive trawls for hydrated anchovy females.

	Egg Surveys						Adult Surveys				
	Stn	+Stn	Eggs	T^a	A0	A1	Trwl	+Trwl	+Hyd	Males	Females
1998	253	116	822	21.7	7966	5329	28	17	10	302	399
1999	107	49	163	20.8	549	769	11	11	4	197	352

Table 2. Fitted linear models.

	Regression Fij-Wij*	Regression Wij-Wij*
1998	$F_{ij} = 219.07 + 320.08\ W_{ij}^*$ (n=67; R^2=0.5238; p<0.001)	$W_{ij} = -0.0663 + 1.0461\ W_{ij}^*$ (n=292, R^2=0.9983; p<0.001).
1999	$F_{ij} = -2617.89 + 630.83\ W_{ij}^*$ (n=30; R^2=0.7973; p<0.001)	$W_{ij} = 0.1333 + 1.0260\ W_{ij}^*$ (n=280, R^2=0.9975; p<0.001).

Table 3. DEPM parameter and biomass estimates from Sicilian Channel anchovy.
A in km^2, P referred to sampling unit (0.05m^2).

	A	P1	P	Z	W	R	F	S	B
1998	13295	3.28	1.31	1.63	15.18	0.59	4835	0.14	13224
		(0.21)	(0.33)	(0.33)	(0.06)	(0.12)	(0.16)	(0.12)	(0.22)
1999	1318	2.18	1.27	2.06	14.08	0.55	5871	0.17	853
		(0.21)	(0.27)	(0.23)	(0.07)	(0.10)	(0.11)	(0.10)	(0.25)

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