METHODOLOGICAL, BIOLOGICAL AND ENVIRONMENTAL FACTORS AFFECTING THE DEPM PARAMETERS VARIABILITY IN THE MEDITERRANEAN ANCHOVY

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Abstract

Methodological, biological and environmental factors affecting the DEPM egg and adult parameter estimates in the Sicilian Channel in 1998 and 1999 are identified, analyzed and compared with other Mediterranean regions. The Sicilian Channel anchovy population represents a discrete stock highly influenced by the hydrological/climatic regime prevailing in the area and the oligotrophic nature of its waters. These environmental conditions affect its reproductive potential as shown by the batch fecundity, spawning fraction and daily egg production estimates that represent the lowest found in the Mediterranean.

Keywords : Pelagic, Fishes, Reproduction, Sicilian Channel

The DEPM has been used to evaluate the anchovy spawning biomass of the Catalan sea in 1990 (1), Catalan Sea-Gulf of Lions in 1993 and 1994 (2), Ligurian-North Tyrrhenian seas in 1993 (2), North Aegean sea in 1993 (3 and 4), south-western Adriatic sea in 1994 (5), and Sicilian Channel in 1998 and 1999 (6). This communication aims to compare these estimates, identifying and analysing the factors affecting the DEPM parameters.

Material and methods

The DEPM methodology applied in the Sicilian Channel is detailed in (7). Bibliography provided the methodology and the DEPM parameters estimates of the other Mediterranean regions (Table 1).

Results and discussion

The daily egg production of the Sicilian Channel was the lowest observed. Only the SW Adriatic exhibit similar values while the other regions present greater estimates. Different methodologies can partially explain it. In the Aegean Sea, where exceptionally greater estimates were found, oblique Bongo tows were done instead of vertical CalVET tows, and the spawning area was not entirely covered. Besides, different temperatures approaches were used to assign ages to eggs in different regions (sub-surface T^a in the Aegean Sea, mean T^a of the first 20 m or 10 m in the Catalan Sea and Sicilian Channel respectively).Despite methodological differences, the Sicilian Channel stock is the less egg productive among the analysed areas : A_1 is the smallest, P and P_1 are the lowest and Z is the highest. Inter-annual variations in the Sicilian Channel are also clear. In 1998 a more expanded spawning area and also a higher egg density occurred, indicating a dramatic decline in spawning intensity caused by environmental and/or biological changes. Differences in adult parameters could also be attributable to methodology. Different fish sampling gears were used, and the adult sampling in the Aegean and Catalan Sea was done with commercial fishing vessels restricting the sampling to commercial fishing grounds. W in the Sicilian Channel was similar to the Catalan Sea, Catalan Sea-Gulf of Lions (93) and Ligurian-Thyrrenian Sea. The other estimates showed greater values indicating the regional, inter-seasonal and inter-annual variation in the size/age structure of this Mediterranean resource. F is strongly correlated with W. Catalan Sea shows greater F values than other regions with similar W due to methodological differences. F is calculated through the Hydrated Oocyte Method (8), but in the Catalan Sea it followed (9). More striking differences not related with the methodology exist. At similar weights, F is much greater in the Aegean Sea than in the Catalan Sea-Gulf of Lions (94), but similar to the Adriatic Sea where W was lower. RF comparison suggests that F differences could be attributable to intra-seasonal or/and inter-annual variations, but also to fecundity differences among the Mediterranean anchovy stocks. In relation to the Sicilian Channel, RF increased 30% in 1999. Although W was 1g lower in 1999, F increased in ± 1000 eggs/batch.

R estimates were quite consistent over time and space.

S estimates in the Sicilian Channel showed the greatest variation in comparison to the rest of the Mediterranean areas.

Anchovy females who are actively spawning are more vulnerable to trawl capture causing an oversampling of day-0 females. Since day-1 and day-2 females were utilised to estimate S in the Sicilian Channel, these low S cannot be attributed to this spawning behaviour. S (as F) increases with size and age (10), but this does not explain the low S estimates in the Sicilian Channel since other Mediterranean regions with similar population structure showed much greater S estimates.

S tends to 0 as the population moves farther from the peak of spawning. The gonad-somatic index evolutions in the Sicilian Channel indicate that the DEPM samplings were done within the peak spawning. One of the most precise methods of determining the end of the spawning period is analysing the degree of atresia. In 1998 the incidence of atretic females was unusually high in some of the first samples, reaching 37.5%. If this atresia was indicative of the end of the spawning period, it could be expected that it increased with time. However, no specimens showed atresia in the subsequent 10 hauls. Therefore, this atresia does not indicate the end of the peak spawning period but the end of the spawning activity of a fraction of this population. In 1999 a substantial amount of inactive females were observed, but not atresia.

If feeding resources are scarce during the spawning period, anchovies can react reabsorbing the oocytes (atresia), prolonging the intervals between spawning and even becoming inactive (11). The Sicilian Channel waters are of oligotrophic nature and the environment is subject to drastic changes in short time periods. The high degree of atretic stages in 1998, the amount of inactive females in 1999, and the low S estimates can be related to these particular conditions. These features can also affect F and P, that are lower than in the other Mediterranean regions analysed.

The inter-annual variation in the Sicilian Channel can be attributable to environmental variability, mainly wind regime, which drives the intensity of upwelling. The great decrease of the anchovy population from 1998 to 1999 could also cause lower competition and a greater feeding availability resulting in the higher reproductive potential observed in 1999 (higher values of F and S with lower W).

Table 1. DEPM egg and adult parameter estimates from different Mediterranean regions.

		Egg Parameters						Adult Parameters							
		T^a	A	A_1	P_1	P	Z	P_t	F	S	W	R	RF	DSF	SF	B
SICILIAN CHANNEL	Jun-Jul 1998	18 5 22 5	13295	5329	65 55 (0.21)	26 27 (0.33)	1 63 (0.33)	0 14 (0.33)	4835 (0.16)	0 14 (0.12)	15 18 (0.06)	0 59 (0.12)	319	26	7	13224 (0.22)
	Jun 1999	18 4 22 7	1318	769	43 62 (0.21)	25 44 (0.27)	2 06 (0.23)	0 02 (0.27)	5871 (0.11)	0 17 (0.10)	14 08 (0.07)	0 55 (0.10)	416	39	6	853 (0.25)
CATALAN SEA	May 1990	17 6 19 6	17081	8095	120 61 (0.15)	57 16 (0.29)	0 56 (0.44)	0 46 (0.22)	8006 (0.02)	0 36 (0.10)	14 25 (0.04)	0 54 (0.09)	562	110	3	4199 (0.26)
	Jul 1990								7283 (0.12)	0 31 (0.16)	12 79 (0.10)	0 56 (0.10)	569	99	3	
CATALAN SEA GULF OF LIONS	July 1993	13 3 22 5	44554	33012	86 67 (0.15)	64 22 (0.17)	1 09 (0.26)	2 12 (0.17)	4958 (0.11)	0 31 (0.13)	14 31 (0.07)	0 64 (0.05)	346	69	3	30849 (0.30)
	May-Jun 1994		42085	31692	81 71 (0.18)	61 53 (0.21)	0 47 (0.26)	1 95 (0.21)	7039 (0.02)	0 21 (0.20)	22 92 (0.06)	0 59 (0.19)	307	38	5	52557 (0.36)
LIGURIAN AND TYRRHENIAN	July 1993	18 9 22 5	15424	8221	93 57 (0.28)	49 87 (0.32)	0 86 (0.34)	0 41 (0.32)	4894 (0.10)	0 32 (0.11)	14 17 (0.07)	0 63 (0.05)	345	70	3	5829 (0.36)
AEGEAN SEA	Jun 1993	16 7 25 0	17396	17396	259 49 (0.32)	259 49 (0.32)	1 04 (0.46)	4 51 (0.32)	11542 (0.04)	0 28 (0.15)	22 73 (0.02)	0 55 (0.04)	508	78	4	58988 (0.35)
SW ADRIATIC	Jul-Aug 1994		14790	9244	50 11 (0.16)	31 32 (0.10)	0 55 (0.12)	0 29 (0.10)	11866 (0.03)	0 16 (0.08)	18 57 (0.03)	0 55 (0.05)	639	56	6	8129 (0.24)

T^a, temperature range (°C)
A, registered in the positive stratum (spawning area).
A_1, total survey area (km²)
P_1, registered in the whole sampled area
F, batch fecundity
P_t, daily egg production per m²
P, daily egg production per m²
S, spawning fraction

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