

# INTERANNUAL DIFFERENCES IN REPRODUCTIVE PARAMETERS AND SOMATIC CONDITION OF ANCHOVY IN THE THRACIAN SEA

Eudoxia Schismenou<sup>1</sup>\*, Argyris Kallianiotis<sup>2</sup>, Athanassios Machias<sup>3</sup> and Stylianos Somarakis<sup>1</sup>

<sup>1</sup> University of Crete, Department of Biology, Iraklion, Crete, Greece - evi.schismenou@edu.biology.uoc.gr

<sup>2</sup> Fisheries Research Institute, Nea Peramos, Kavala, Greece

<sup>3</sup> Hellenic Centre for Marine Research, Iraklion, Crete, Greece

## Abstract

We applied the Daily Egg Production Method (DEPM) to the NE Aegean anchovy, *Engraulis encrasicolus* (Linnaeus, 1758) stock during its peak spawning period in June 2003 and June 2004. Analysis of adult samples revealed significant differences between the two years for the parameters of mean weight of mature females, batch fecundity and spawning frequency which had higher values in 2004. In addition, fish grew faster in weight in 2004. The estimated spawning biomass was about three times lower in 2004 than in 2003.

**Keywords:** Aegean Sea, Stock Assessment, Reproduction, Spawning.

## Introduction

European anchovy is one of the most important pelagic fish in the Mediterranean and the estimation of the spawning biomass of its stocks is an important tool in their assessment [1]. The DEPM is an ichthyoplanktonic method for estimating the reproductive biomass of multiple spawning fish. The application of this method can provide valuable information on the reproductive ecology of these species [1, 2]. The aim of the present study was to examine interannual changes in the DEPM adult parameters of anchovy in the NE Aegean Sea.

## Methods

During the application of the DEPM on the NE Aegean anchovy stock in June 2003 and 2004, samples of adult fish were collected from both experimental and commercial fishing. Each sample consisted of random collection of approximately 50 anchovies. Processing of an adult sample in the laboratory consisted of length and weight measurements (both total and gonad free weight), sexing, fecundity measurements for batch fecundity estimation (mean number of eggs per mature female per spawning, F), and histological analysis for spawning frequency estimation (fraction of mature females spawning per day, S).

Gonads of all processed females were weighted (0.01 mg) and preserved in 10% buffered formalin. The gonads of 20 randomly selected females per sample were subjected to histological analysis. The analysis involved the identification of the maturation stage of the most advanced group of oocytes and the presence and histological characteristics of atretic and postovulatory follicles (POFs) [3].

All macroscopically detected hydrated or running females were measured and their gonads weighted and preserved in formalin for subsequent histological and batch fecundity analysis. In order to assess batch fecundity we applied the hydrated oocyte method and the data were used to fit a linear model regressing the number of eggs per batch to gonad free weight [4, 5]. Spawning frequency was assessed by the postovulatory follicles method [3].

## Results and Conclusions

The biomass and adult parameter estimates of the DEPM are presented in Table 1. In 2004 females were heavier and spawned almost every other day ( $S = 0.44$ ), while in 2003 they spawned every three days ( $S = 0.34$ ). Similarly, the number of eggs released per individual was higher in 2004 (7053 eggs per batch) than in 2003 (3936 eggs per batch). The weight-specific sex ratio was higher than 0.6 during both years.

Since fecundity is calculated indirectly through gonad free weight, the two parameters were correlated. However, the regression lines of fecundity on gonad free weight were forced through zero because the intercept was not significant at the 0.05 level. This indicated that the F/W ratio (relative fecundity, eggs  $g^{-1}$ ) was not size dependent. In addition, spawning frequency was not related to weight in 2003 or 2004 (Spearman rank correlation,  $r_s = -0.135$ ,  $P = 0.581$  and  $r_s = 0.468$ ,  $P = 0.060$  respectively).

In addition, the comparison of total length-gonad free weight relationships revealed that, in 2004, fish were growing in weight significantly faster (slope:  $b=3.1$ ) than in 2003 (slope:  $b=2.7$ ) (ANCOVA,  $F = 69.25$ ,  $P < 0.001$ ), which indicated better feeding conditions in 2004.

These differences in reproductive performance and somatic condition could not be attributed to ambient food availability since concurrently measured zooplankton biomass was similar between years ( $P > 0.05$ ). However, estimates of spawning biomass (Table 1) indicated that the size of the

stock was almost three times larger in 2003 (17600 t) than in 2004 (6251 t). These observations suggest that the aforementioned differences can be explained in terms of density-dependence [2].

Tab. 1. Biomass and adult parameter estimates of the DEPM applied to the NE Aegean anchovy stock in June 2003 and June 2004.

Parameter	2003	2004
Mean weight of mature female (W, g)	15.36 (CV=0.022)	18.92 (CV=0.039)
Weight specific sex ratio (R)	0.65 (CV=0.038)	0.63 (CV=0.077)
Fraction of mature females (S)	0.34 (CV=0.062)	0.44 (CV=0.051)
Average batch fecundity (F, number of eggs)	3936 (CV=0.049)	7053 (CV=0.047)
Spawning biomass (SSB, t)	17600 (CV=0.220)	6251 (CV=0.247)

## References

- 1 - Somarakis S., Palomera I., Garcia A., Quantanilla L., Koutsikopoulos C. and Motos L., 2004. Daily egg production of anchovy in European waters. *ICES J. Mar. Sci.*, 61: 944-958
- 2 - Somarakis S., 2005. Marked interannual differences in reproductive parameters and daily egg production of anchovy in the northern Aegean Sea. *Belg. J. Zool.*, 135 (2): 247-252
- 3 - Hunter J.R. and Macewicz B.J., 1985. Measurement of spawning frequency in multiple spawning fishes. In: Lasker R. (ed), An egg production method for estimating spawning biomass of pelagic fish: Application to the Northern anchovy, *Engraulis mordax*. NOAA Technical Report NMFS 36, pp.79-93
- 4 - Hunter J.R., Lo N.C.H. and Leong R.J.H., 1985. Batch fecundity in multiple spawning fishes. In: Lasker R. (ed), An egg production method for estimating spawning biomass of pelagic fish: Application to the Northern anchovy, *Engraulis mordax*. NOAA Technical Report NMFS 36, pp.67-77
- 5 - Somarakis S., Koutsikopoulos C., Machias A. and Tsimenides N., 2002. Applying the daily egg production method (DEPM) to small stocks in highly heterogeneous seas. *Fish. Res.*, 55: 193-20