GROWTH RATES OF EARLY LIFE STAGES OF *ENGRAULIS ENCRASICOLUS* AND *SARDINA PILCHARDUS* IN THE ADRIATIC SEA (ITALY)

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Abstract
Early life stages of anchovy and sardine were collected in the Adriatic Sea during three seasonal surveys carried out between June 2007 and February 2008. Growth rates were estimated by daily increment counts on sagittal otoliths. Age estimates were made on late-larvae specimens, just before the transition from larval to juvenile stage. Growth of these vulnerable stages may be an important factor affecting recruitment success.
Keywords: Adriatic Sea, Pelagic, Larvae, Growth, Fishes

Introduction
Small pelagic fishes, especially anchovy *Engraulis encrasicolus* and sardine *Sardina pilchardus*, are important species in the Adriatic Sea, from both ecological and socio-economic points of views [1]. A major gap in the management of small pelagic fish stocks in the Adriatic Sea as well as in the whole Mediterranean Sea, is the limited knowledge of the basic aspects of early life stages. The stock biomass depends primarily on the strength of recruitment and on the survival/viability of early life stages. Consequently, knowledge regarding growth rates of the vulnerable stages in these pelagic species may be useful to understand the factors affecting year class strength and subsequent biomass of the adult population, as well as being essential for management purposes.

Materials and Methods
Three seasonal surveys of anchovy and sardine late-larvae were carried out between June 2007 and February 2008 by means of a pelagic trawl (mesh size 5 mm stretched) in two nursery areas along the Adriatic coast (off the Po river and in the Gulf of Manfredonia). In the laboratory, late larvae were measured to the nearest mm below (standard length, SL) and weighed with an accuracy of 0.01 g (TW). Sagittal otoliths preparation and interpretation procedures are described in [2]. The growth rates of sardine and anchovy late larvae were estimated by fitting linear regressions to the whole age-length dataset, as follows: SL = a+ b*age (days) where a would be the fish standard length at age 0 (i.e. the estimated length at exogenous feeding when the first increment is laid down) and b is the instantaneous growth rate of juvenile anchovy. Moreover, the allometric length - weight relationships were calculated for both species applying a non-linear regression: $TW = a*SL^b$. For anchovy, growth rates (mm·day^{-1}) and SL–TW relationships obtained in the two sampling periods (June and November) were compared, over a common size range (11 – 38 mm SL), by means of Analysis of Covariance (ANCOVA).

Results and Discussion
Anchovy larvae were collected in June 2007 (n = 50) in the Gulf of Manfredonia and in November 2007 (n = 78) off the Po mount. The June sample consisted of a slightly wider size range (SL: 7-38 mm) than in the November sample (SL: 11-40 mm). Sardine late larvae were caught in February 2008 only (n = 78) and SL ranged from to 18 to 35 mm. The relationship between standard length (SL) and age (days), obtained for the two species, are shown in Fig. 1 and 2.

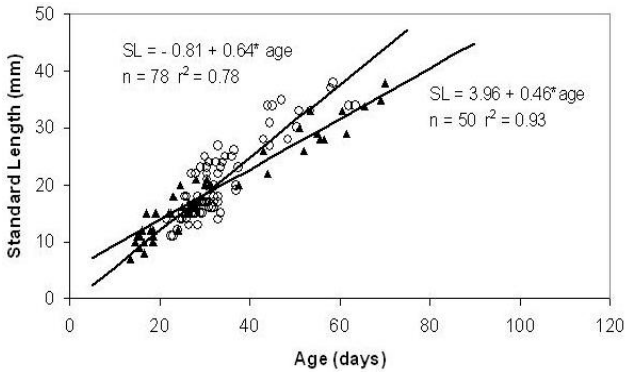

Fig. 1. Age-SL relationship estimated for anchovy late larvae collected in June'07 (triangle) and November'07 (circle)

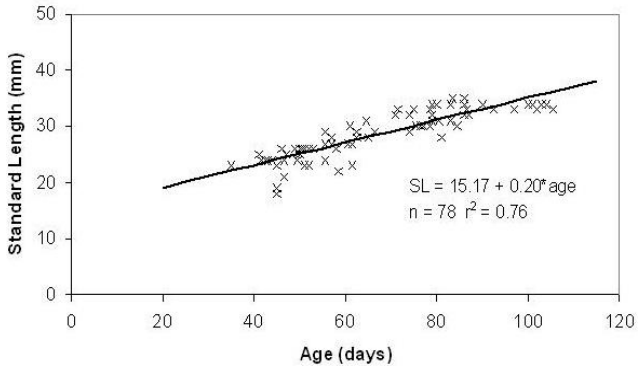

Fig. 2. Age-SL relationship estimated for sardine late larvae collected in February'08

The relationship SL-TW were described by the following equations: $TW = 1.51*10^{-06}SL^{3.43}$, $r^2 = 0.98$ for June anchovy; $TW = 7.93*10^{-07}SL^{3.56}$, $r^2 = 0.94$ for November anchovy and, $TW= 3.81*10^{-07}SL^{3.78}$, $r^2 = 0.84$ for sardine. The instantaneous growth rate estimated for sardine late larvae (0.20 mm·day^{-1}) was lower than those estimated for anchovy (0.46 and 0.64 mm·day^{-1} in June and November, respectively). Length-at-age of anchovy caught in November were significantly higher than those collected in June ($F = 20.97$; $p<0.001$) whilst no significant differences were found for growth-in-weight ($F = 1.50$; $p = 0.22$). These results obtained for anchovy partially disagree with the general pattern observed in another Adriatic area (Ortona) where the instantaneous growth rate picked in May and decreased in August and November [3]. Seasonal changes in environmental and trophic conditions largely affect instantaneous growth rate, indicating that the environment (e.g. food availability) was more favourable off the Po river mouth. Positive effects of temperature and food on the growth of fish are well documented [4], and in the case of anchovy the higher growth rate in November is probably related to trophic rather than temperature changes.

References
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