VARIABLE GROWTH OF BULLET TUNA LARVAE (*AUXIS ROCHEI*) RELATED TO HYDROGRAPHIC SCENARIOS OFF THE BALEARIC SEA

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Abstract
Biometric differences consequent with variable growth were observed in bullet tuna larvae collected under different hydrographic conditions delimiting water masses of Mediterranean and Atlantic origin. Larger and heavier larvae with higher growth rates were found in the Mediterranean waters together with higher mesozooplankton abundance.
Keywords: Larvae, Growth, Balear Sea

Introduction
Bullet tuna, *Auxis rochei*, represents one of the most abundant small tuna species commercially exploited in the Mediterranean Sea. The high scombroid growth rates at early life stages have been related to high food requirements and environmental conditions [1]. The aim of this study is to corroborate the linkages between hydrographic conditions and food availability with biometric features in bullet tuna larvae collected under specific hydrographic water masses.

Material and Methods
Specimens of early stages of *Auxis rochei* were collected in August 2008 off Mallorca Island (Balearic archipelago, Western Mediterranean), during daytime, by means of oblique tows through the upper mixed layer, above the thermocline. Hauls were performed at a speed of two knots, with Bongo 90 net fitted with 500 mm meshes. A Bongo 20 net, equipped with 100 and 200 mm meshes, was placed 1 m above Bongo 90 frame for mesozooplancton sampling. Some tuna larvae from both 500 mm meshes were sorted on board and stored in liquid nitrogen, whereas the rest was preserved in 96% ethanol (replicate 1) and 2% formaldehyde in seawater (replicate 2). Larvae preserved in ethanol were used for daily growth analysis [2]. Once in laboratory, larvae preserved in N2 were measured and weighed for standard length (SL) and dry weight (DW) determination. Zooplankton biomass for the size fractions 100-250 µm and >250 µm was determined drying the samples to a constant weight, and referred to the volume of filtered water (mg/m^3). Hydrographic data were collected at each sampling station using a CTD profiler. A principal component analysis (PCA) was carried out to characterize different stations in relation to environmental features (86.6 % representation). To run this PCA, mean temperature (T), salinity (S) and oxygen (O) in first 5 m, were selected after linear correlations between variables were performed.

Results and Discussion
The different stations were grouped in two classes according to the PCA analysis of the hydrographic conditions: group A, characterized by higher T and S values, and group B with lower T and S values. Both groups represent Mediterranean (MW) and Atlantic (AW) waters respectively [3] (Fig. 1).

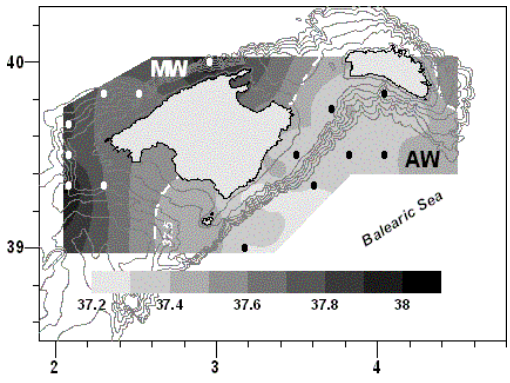

Fig. 1. Stations sampling distribution according to the PCA analysis in the study area. Mediterranean-MW (white) and Atlantic-AW (black) overlapped to salinity contours.

The SL and DW ANOVA analysis between groups shows significantly larger (p<0.001) and fatter (p=0.002) bullet tuna larvae located in MW (7 stations, 47 larvae, mean SL 7.1 mm and mean DW 0.58 mg) with respect to the AW (7 stations, 49 larvae, mean SL 6.0 mm and mean DW 0.28 mg). These differences are not merely attributable to differences in larval ages distribution; but to higher growth rates (ANCOVA $F_{1, 57}$=7.16, p=0.01) in the larvae inhabiting MW (Fig. 2), which is in agreement with higher Fulton's condition factor in MW larvae (0.137) than in AW ones (0.101) (p=0.006).

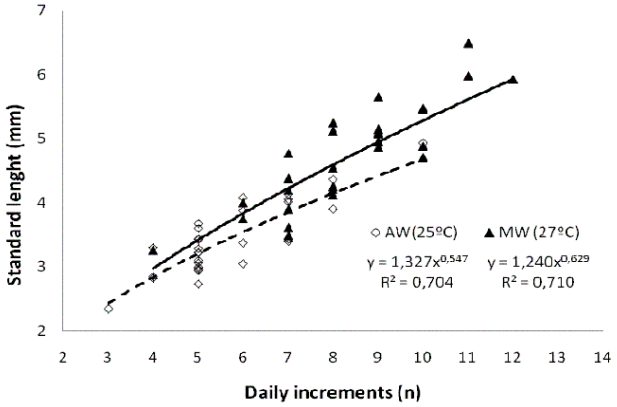

Fig. 2. Daily growth for bullet tuna larvae in both AW and MW.

These differences are partly due to higher temperatures of MW waters [4]; but could be also a result of higher availability of larger preys, which according to previous studies constitute the major dietary component [5], since size fractioned zooplankton analysis revealed a 7-fold greater biomass (p<0.001) in the fraction >250 µm in MW stations. Moreover, recent studies have shown that the probability of finding bullet tuna larvae increases with higher mesozooplankton biomass (>200 µm) [6].

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