DIFFERENTIATING DAILY GROWTH STRATEGIES WITH STABLE ISOTOPE ANALYSIS FOR TROPHISM OF ALBORÁN SEA SARDINE LARVAE

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Abstract
A combined study of Alboran Sea sardine larval growth which differentiated two different growth strategies with stable isotope analysis for trophism yielded no trophic differences between both the two populations. The faster growing larvae showed higher C:N relationship in relation to the slower growing larvae.
Keywords: Larvae, Alboran Sea, Growth, Trophic Relations

Introduction
Sardine is a key species of the neritic ecosystem off the Alboran Sea coasts, constituting its major small pelagic resource. Its economic and ecological interest has been manifest through studies focusing on early life daily growth [1] and larval condition [2]. This study intends to provide new insights in larval growth variability with stable isotope analysis.

Material and Methods
A single catch of schooling post-flexion sardine larvae was sampled to study trophic influence on daily growth variability. The larval school was sampled at night time by means of a surface Bongo 90 tow off the nearshore coasts of Málaga. Larvae were sorted on board and stored in liquid nitrogen. Sampling and laboratory procedures are described in [3]. In the laboratory, larvae were thawed, measured for standard length (SL) and dry weighed (DW) after dry freezing during 24 hours. Otolith microstructure analysis allowed estimating the daily growth of larvae as described in [3] while natural abundance of ^{15}N ($\delta^{15}N$, %) and ^{13}C ($\delta^{13}C$, %) were measured using an isotope-ratio spectrometer (Thermo-Finnigan Delta-plus) coupled to an elemental analyser (FlashEA1112 Thermo-Finnigan). The determinations were calibrated against atmospheric nitrogen and PeeDee Belemite, respectively. using acetanilide as standard.

Results and Discussion
The sardine larval school comprised exclusively post-flexion larvae ranging from 12.2-19.0 mm standard length (SL). The SL vs DW relationship of the larval cohort differentiated two relative growth relationships originating from different growth strategies, that is, a normal growing population (N) in contrast with a slower growing larval population (S) investing growth energy in gaining somatic weight rather than length (Fig. 1). Their respective LnAGE vs LnSL and LnDW relationship is significantly different. LnSL and LnDW of the N growing population is greater than the S larvae (ANCOVA $F_{1, 176}$=142.8, p<0.001). $\delta^{15}N$ averaged 7.07‰ (± 0.50), indicating trophism within the phytoplankton size fraction around the 200mm threshold, while $\delta^{13}C$ averaged -17,9‰ (± 0.63). A previous study indicates that the values of $\delta^{15}N$ and $\delta^{13}C$ for the particulate organic matter fraction <200 mm, which is mainly phytoplankton in the study area during spring- is 3.71‰ (± 1.07) and 21.93‰ (± 0.58), respectively.

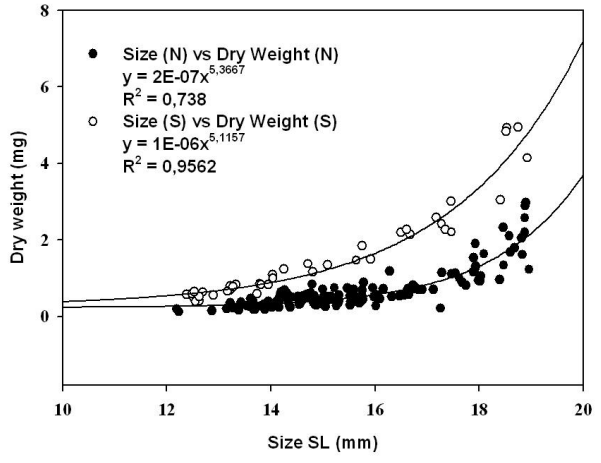

Fig. 1. Dry weight vs SL

The isotopic enrichment of the N from the particle pool <200 mm to sardine larvae was about 3.8‰. The relatively low nitrogen enrichment indicates that this plankton fraction constitutes the main diet of the sardine larvae. Nevertheless, the N and S populations did not show significant differences (ANOVA, p>0.05) in respect to $\delta^{15}N$ and $\delta^{13}C$, and therefore, no dietary difference. A greater gain in somatic mass with age in the S population is corroborated with a significantly greater Nitrogen percentage (N%) (ANCOVA $F_{1, 135}$=9.7, p<0.01), while the greater growth potential of the N population is in agreement with its significantly greater Carbon percentage (C%). The Fulton index, indicative of energy storage in individuals showed significant linear increase with age in both populations (r^2=0,72 and 0.92, respectively), whereby the S larvae showed significantly higher values than the N larvae (ANCOVA $F_{1, 176}$=461.1, p<0.001). Lastly, the C:N relationship showed a significant decrease with age/size of both populations (Fig. 2) similar to the growth rate decline with age/size. N larvae presented a greater C:N ratio than the S larvae (ANCOVA $F_{1, 135}$=63.6, p<0.001) demonstrating a greater investment of the N larvae in the structural development of larvae with time rather than energy reserve components.

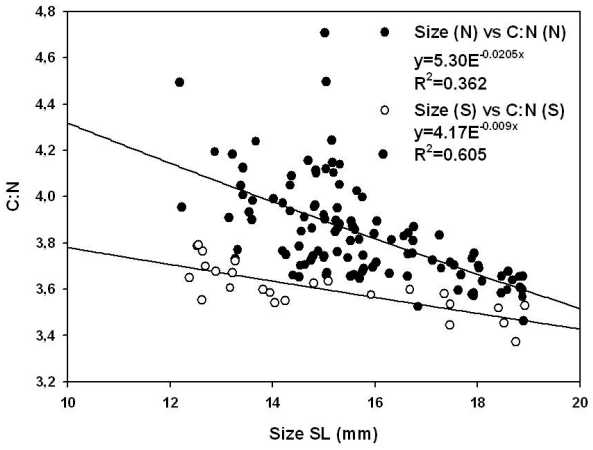

Fig. 2. C:N vs SL

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