

EVIDENCING GROWTH-DEPENDENT SURVIVAL OF ALBORAN SEA SARDINE (*SARDINA PILCHARDUS*) LARVAE IN THE FIELD

Alberto García *, Dolores Cortés , Jose Quintanilla and J.M. Rodriguez
Instituto Español de Oceanografía, 29640 Fuengirola, Málaga, Spain - agarcia@ma.ieo.es

Abstract

A field exercise based on the collection of pre-flexion sardine larvae in a nursery site at a determined site which was revisited two weeks later aiming to sample the surviving post-flexion larval cohorts showed that back-calculated post-flexion larvae lengths were larger at age than pre-flexion larvae, thereby indicating that survival is linked to higher growth potential, which is corroborated by the significant differences in the average widths of daily increments and the size of the otolith core between the pre- and post-flexion larvae.

Keywords : *Alboran Sea, Growth, Larvae.*

Introduction

Growth of larvae and juveniles in many fish species may be an important causative factor inducing relative recruitment success [1], because lower growth rates may cause higher mortality by shortening the vulnerable periods of early life. Inshore waters of the Bay of Málaga constitute nursery grounds for sardines and anchovies that were exploited by artisanal fisheries in the past [2]. Advanced larval stages concentrate in shallow waters off Málaga, thus providing ideal conditions to investigate larval growth by otolith analysis. To test the growth mortality hypothesis [1] in the field, larval cohorts at early life periods were sampled in their nursery ground and revisited in the future to analyze the growth characteristics of surviving larval cohorts.

Material and Methods

A larval sampling survey on board the *R/V Odón de Buén* was carried out in the inshore nursery sites off the coasts of Málaga during February 14-17 2004 with the objective of collecting pre-flexion larvae (Nursery I). Larval sampling methods and on-board conservation procedures are described in [3]. Over two weeks later (March 2-4) the same site was revisited to sample post-flexion larvae (Nursery II).

Bearing in mind that the relationship between sardine larval size and otolith radius follows non-linear power functions, the back-calculation formula of [4] was applied,

$$L_i = (S_i/S_c)^\nu \cdot L_c$$

where, L_i is back-calculated standard length (SL) at radius size S_i , and L_c and S_c corresponds to the individual SL at catch and radius at catch, respectively, and ν is the exponent of the larval size vs otolith radius regression equation. Statistical tests were done by ANCOVA using the natural logarithm of increment counts as covariable.

Results and Discussion

The Nursery I survey sampled a total of 75 pre-flexion larvae that were born from February 3-11, 2004, while the Nursery II captured a total of 95 post-flexion larvae whose birthdates ranged from 20/01/2004-16/02/2004. Among these, 37 larvae had coincident birthdates with larvae sampled in Nursery I (February 3-11). Since the elapsed time between the first and second sampling period was approximately 17 days, a group of 79 post-flexion larvae that were born from March 27-February 12 was established to trace their early growth trajectories. The back-calculated growth trajectories of the original population sampled in the Nursery I survey was compared to the back-calculated growth history of the surviving larvae (Nursery II) born during the same period (February 3-11) as the original population, as well as, the larval cohort born from March 27-February 12 (Fig. 1). The larvae born during the coincident birthdate period of Nursery I larvae, as well as, those born for the extended dates from the Nursery II samples show significantly greater back-calculated standard lengths at age than the original population ($F_{2,35}=71.7$, $p<0.001$). To corroborate this finding through back-calculation procedures, it was necessary to examine otolith growth and increment width deposition in the original and the surviving cohorts, as these parameters are correlated with the somatic daily growth and metabolic rates [5]. The difference in growth between the original larval population and the surviving cohorts sampled at a later period is sustained by the significant difference observed in the mean width of increment deposition (Fig. 2) in favour of the surviving larvae (ANCOVA: $F_{1,23}=55.8$, $p<0.001$). This difference is in agreement with otolith growth difference between the original population and their

survivors ($F_{1, 23}=19.9$, $p<0.001$). Furthermore, the average otolith core at hatch was significantly greater (over $2\mu\text{m}$) in the surviving cohorts than in the original population (ANOVA, $F_{1,168}=716.1$, $p<0.001$) in agreement with the difference observed in the estimated larval size at hatch between the back-calculated growth trajectories of both larval populations, which showed an average a difference of 1.5 mm between the surviving and the original larval population, thereby possibly inducing greater growth potential at early life stages as evidenced by [6].

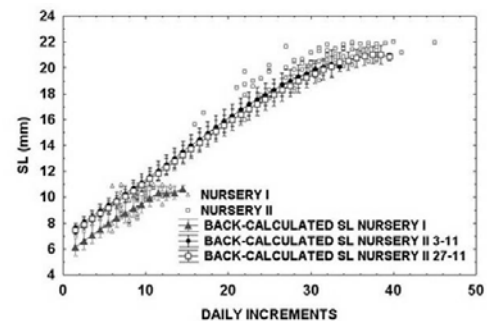


Fig. 1. Back-calculated growth trajectories of the original and surviving larval population.

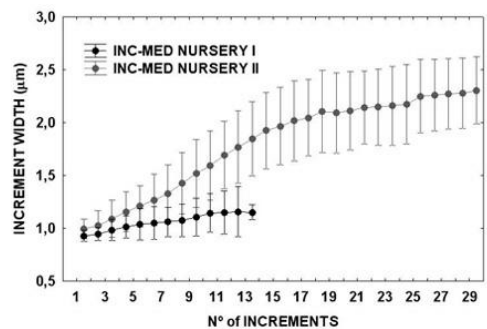


Fig. 2. Increment widths of the original and surviving larval population.

References

- 1 - Anderson, J.T. 1988. A review of size dependent survival during pre-recruit stages of fishes in relation to environment. *J. Northwest Atl. Fish. Sci.*, 8:55-66.
- 2 - García, A., D. Cortés, T. Ramírez, A. Giráldez y A. Carpena (2003). Contribution of larval growth rate variability to the recruitment of the Bay of Málaga anchovy (SW Mediterranean) during 2000-2001 spawning seasons. *Sci. Mar.* 67(4): 477-490.
- 3 - Folkvord, A. and Mosegaard, H. 2002. Growth and growth analysis. In *Manual of fish sclerochronology* (Panfili J., Pontual H. (de), Troadec H., Wright P.J., eds.) pp. 146-166. Brest, France: Ifremer-IRD coedition.
- 4 - Takahashi, M. and Y. Watanabe. 2004. Growth rate-dependent recruitment of Japanese anchovy *Engraulis japonicus* in the Kuroshio-Oyashio transitional waters. *Mar. Ecol. Prog. Ser.*, 266: 227-238.