The Atlantic chub mackerel (*Scomber colias*) in the Iberian Atlantic waters: growth patterns and cohorts strength

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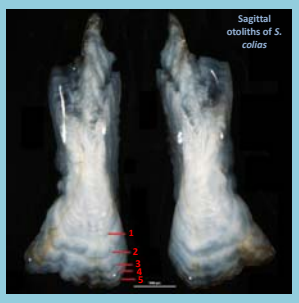
INTRODUCTION

The Atlantic chub mackerel (*Scomber colias*) is one of the main small pelagic fish resources in the Central-East (CE) Atlantic. It has become an important resource in Atlantic Iberian waters in the most recent period, after the northward expansion in its geographical distribution.

OBJECTIVE

To analyse and identify geographical variations in the demographic structure, abundance at age, cohorts and growth pattern by area of *S. colias* in the Atlantic Iberian waters in the last decade.

MATERIAL & METHODS



Samples: 21,491 sagittal otoliths collected from commercial catches and research surveys by IEO-CSIC (Spain) and IPMA (Portugal) from 2010 to 2020, within the EU-Data Collection Framework.

Study area: the Atlantic Iberian waters, from the Cantabrian Sea up to Gulf of Cadiz, considering seven ICES Subdivisions.

Age estimation: estimated following the international *S. colias* standardized criteria (ICES, 2016).

Abundance indices: obtained from the age-length keys by year from surveys or commercial, which allowed us to obtain a proxy of the demographic structure of each area in the period studied. Hablar con Charo

Growth parameters: from von Bertalanffy growth function (VBGF) (Von Bertalanffy, 1938) by applying a nonlinear regression using sequential quadratic programming:

$$L_t = L_\infty (1 - \exp(-k\,(t - t_0)))$$

where L_t = Length at time t, L_∞ = theoretical asymptotic length, k =growth rate parameter, t_0 = the age of the fish at zero length, t = age in years.

The **growth performance index** (Φ') was calculated using the equation devised by Pauly and Munro (1984) to compare the growth patterns:

$$\Phi' = \log 10k + 2\log 10\, L_\infty$$

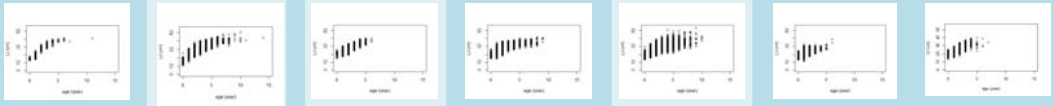
where L_∞ and k are parameters of von Bertalanffy growth equation.

RESULTS & DISCUSSION

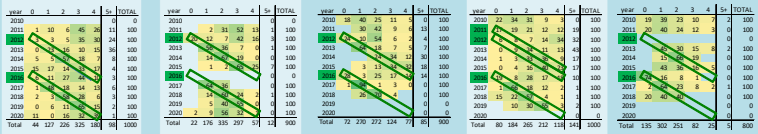
Abundance at age and cohort tracking by area

SE Bay of Biscay	Cantabrian Sea & NW Galician waters	SW Galician waters	NW Portuguese waters	SW Portuguese waters	Algarve waters	Gulf of Cadiz
8.b	**8.c**	**9.a.n**	**9.a.c.n**	**9.a.c.s**	**9.a.s.a**	**9.a.s.c**

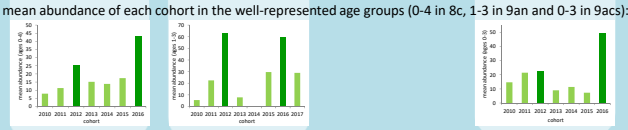
Variation in the demographic structure of *S. colias* among areas: higher proportion of older and larger individuals in central Portuguese waters (9.a.c.n-9.a.c.s) and in the Cantabrian Sea (8.c)



Abundance at age group (in % by year), only from those areas where age estimates are available for the vast majority of years. 8b and 9asc only have 5-6 years of data available:

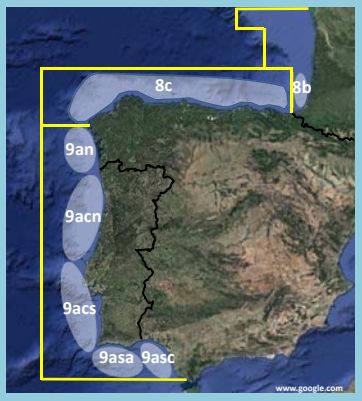


Proxy mean abundance of each cohort in the well-represented age groups (0-4 in 8c, 1-3 in 9an and 0-3 in 9acs):

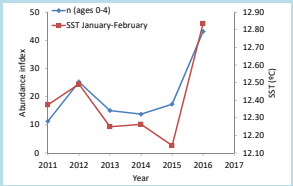


• **Two strong cohorts (2012 & 2016)** stand out **in all areas.**

• The **2011 cohort** also stands out in the south (**9.acs**).

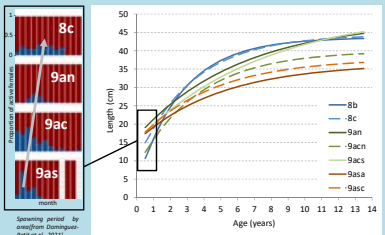


Environmental drivers



A preliminary analysis **correlates (r=0.89) the annual strength of these cohorts (2011-16) in the Bay of Biscay (8.c) and the January-February SST,** indicating an environmental influence on their abundance indices.

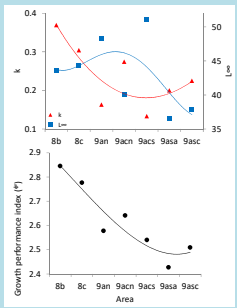
Growth by area



The **mean length at the first age group is smaller in the northernmost areas** (8.b and 8.c), what could be influenced by a later spawning process (Dominguez-Petit et al., 2021) and a shorter growth period during their first year of life.

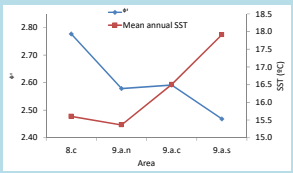
S. colias **growth is faster in the northernmost areas** (southern Bay of Biscay: 8.b and 8.c) and slower in the southernmost ones (Algarve and Gulf of Cadiz: 9.a.s.a and 9.a.s.c), with a steeper growth slope in the first age group in northern Iberian waters.

The growth performance index (Φ') shows a **clear downward north-south trend**, confirming preliminary observations from few previous studies (Navarro et al., 2021).



Von Bertalanffy growth parameters
for combined sexes by area

ICES Subdiv.	L_∞	k	t_0	Φ'	n
8b	43.61	0.37	-0.26	2.85	367
8c	44.36	0.30	-0.85	2.78	8364
9an	48.21	0.16	-2.59	2.58	2536
9acn	40.00	0.27	-0.85	2.64	2225
9acs	51.11	0.13	-2.73	2.54	4144
9asa	36.58	0.20	-2.74	2.43	1632
9asc	37.91	0.23	-2.32	2.51	2223



An **inverse correlation (r=-0.72)** is preliminarily observed between **growth (Φ') and mean annual TSS by area**, showing also the environmental influence on growth.

CONCLUSIONS & FURTHER WORK

- Coincidence of noticeable cohorts among areas suggests **common favourable conditions** in Iberian Atlantic waters for the survival of *S. colias* early life stages during previous years (2012, 2016) and a relative **population connectivity** among areas.
- An Iberian north-south **gradient** is observed for the **growth pattern** of *S. colias* is observed using a standardized age estimation criteria on otoliths.
- Updated **growth parameters** of the various areas of Iberian Atlantic *S. colias* based on a significant sample size over a multi-year period are here available **for** use in the ICES **stock assessment** using age-structured models.
- The **inter-institutional collaboration** (IEO-IPMA) collecting complementary data that has made this work possible is specially relevant for the study of this type of migratory species.
- These and other biological results from North Atlantic populations of *S. colias* indicate that it is necessary **to deepen** the knowledge of their **population structure and connectivity** using a holistic approach, which would favour an adequate management of their stocks.
- Further studies on the relevance of **environmental drivers** in recruitment, cohort strength and growth pattern in the distribution areas of *S. colias* are new challenges to be addressed.

ACKNOWLEDGEMENTS

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