


Interannual analysis of the biological parameters of *Trachurus mediterraneus* (Steindachner 1868) in the Spanish Mediterranean Sea


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CSIC Consejo Superior de Investigaciones Científicas

MEDIAS MEDiterranean International Acoustic Survey

MECM Máster en Ecología Marina

ASLO 2021 AQUATIC SCIENCES MEETING

INTRODUCTION

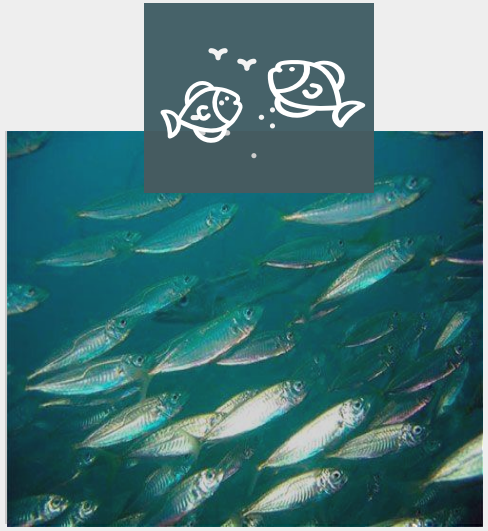
Trachurus mediterraneus **(Steindachner 1868) Carangidae family, important fishery resource in the Mediterranean Sea**

Distribution

- Semi-pelagic and oceanodrome
- Between 40 and 200 m depth
- Muddy and sandy bottoms
- Mediterranean, Marmara and Black Seas

Biology

- Spawning: spring and summer
- Maximum size of 40-60 cm
- Lifespan: 10 and 12 years
- Feeding on larvae and crustaceans



Studies

- ¿Adriatic Sea? ✅
- ¿Marmara Sea? ✅
- ¿Black Sea? ✅
- ¿Spanish Mediterranean Sea? ❌

(Smith-Vaniz et al. 1986; Fischer et al. 1987; Relini et al. 1999; Ragonese et al. 2002; Turan 2004; Fernandez-Jover et al. 2007; Mir-Arguimbau et al. 2019)

INTRODUCTION

LFD

-Recruitment
-Growth
-Mortality

L_{50}

-Length at first maturity
-Minimum catch size

L-W

Stock assessment-
Biomass estimation-
Fish condition-

CF

Physiological state-
Reproduction-
Feeding processes-

Considering the scarcity of information regarding the biological parameters and population structure of *T. mediterraneus* in the Spanish Mediterranean, the present research aims to analyze the temporal evolution of the biological parameters of this species.

Petrakis and Stergiou 1995; Gonçalves et al. 1997; Richter et al. 2000; Froese 2006; Neumann y Allen 2007; Hashiguti et al. 2018

MATERIALS AND METHODS

Study area

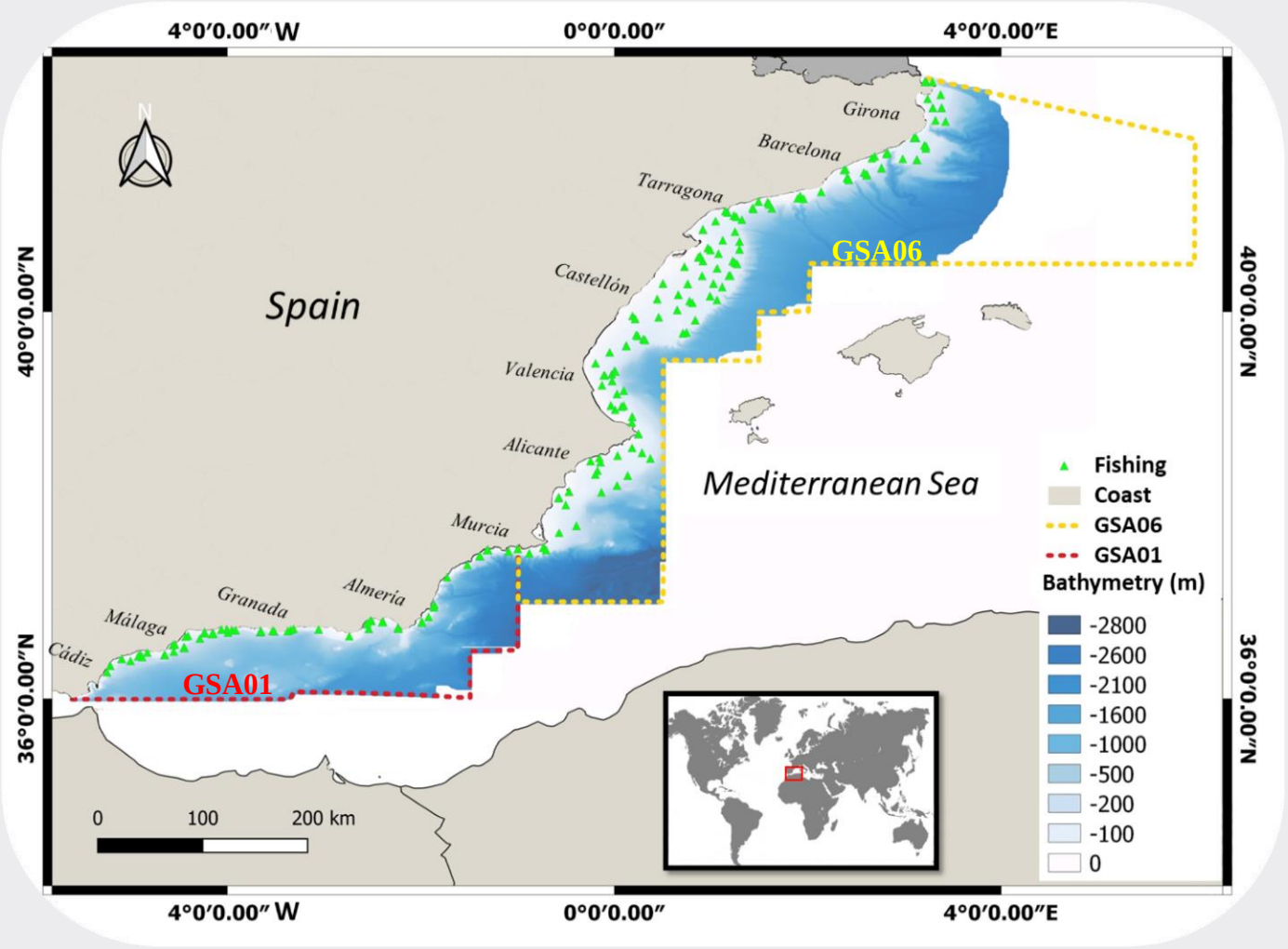


Figure 1. Geographical location of the study area located in the Spanish Mediterranean Sea.

Pelagic trawls
from 2016 to 2020 (June-July)

From 30 to 200 m depth

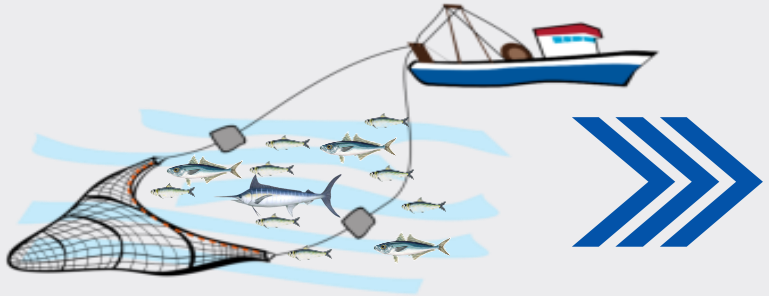
Transects

8 nautical miles → **GSA06**

4 nautical miles → **GSA01**

Sampling

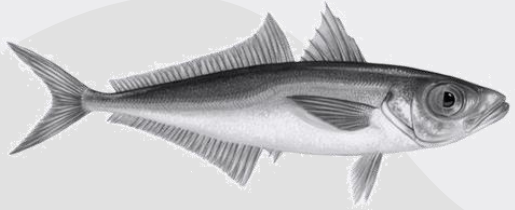
Pelagic trawls



Separation by species

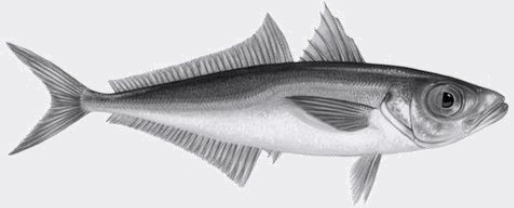
Group of 0.5 cm

Step 1



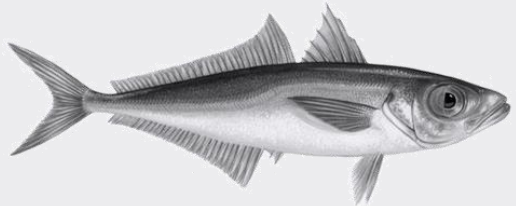
Total length

Step 2



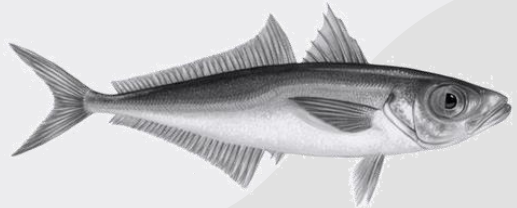
Wet weight

Step 3



Sex

Step 4



Maturity

Statistics

Length frequency distribution (LFD) → Bhattacharya method → Kolmogorov-Sminov (K-S) test **(Neumann and Allen 2007)**

Length-weight relationship (L-W) → $W_i = \alpha L_i^{\beta} e^{\in_i}$ (1)
- Two-way analysis of variance
- β≠3 t-Student test

Condition factor (CF) → $K = \frac{W_i}{L_i^{\beta_i}} * 100$ (2) → Analysis of covariance → Tukey

Sex ratio (Zar 1996) → $\chi^2 = \sum \frac{(o_i - e_i)^2}{e_i}$ (3)

Chi-square contrast test

Size at first maturity (L_{50}) → $p = \frac{100}{1 + e^{(\alpha+\beta)*L}}$ (4) → Generalized linear model

Length frequency distribution (LFD)

RESULTS

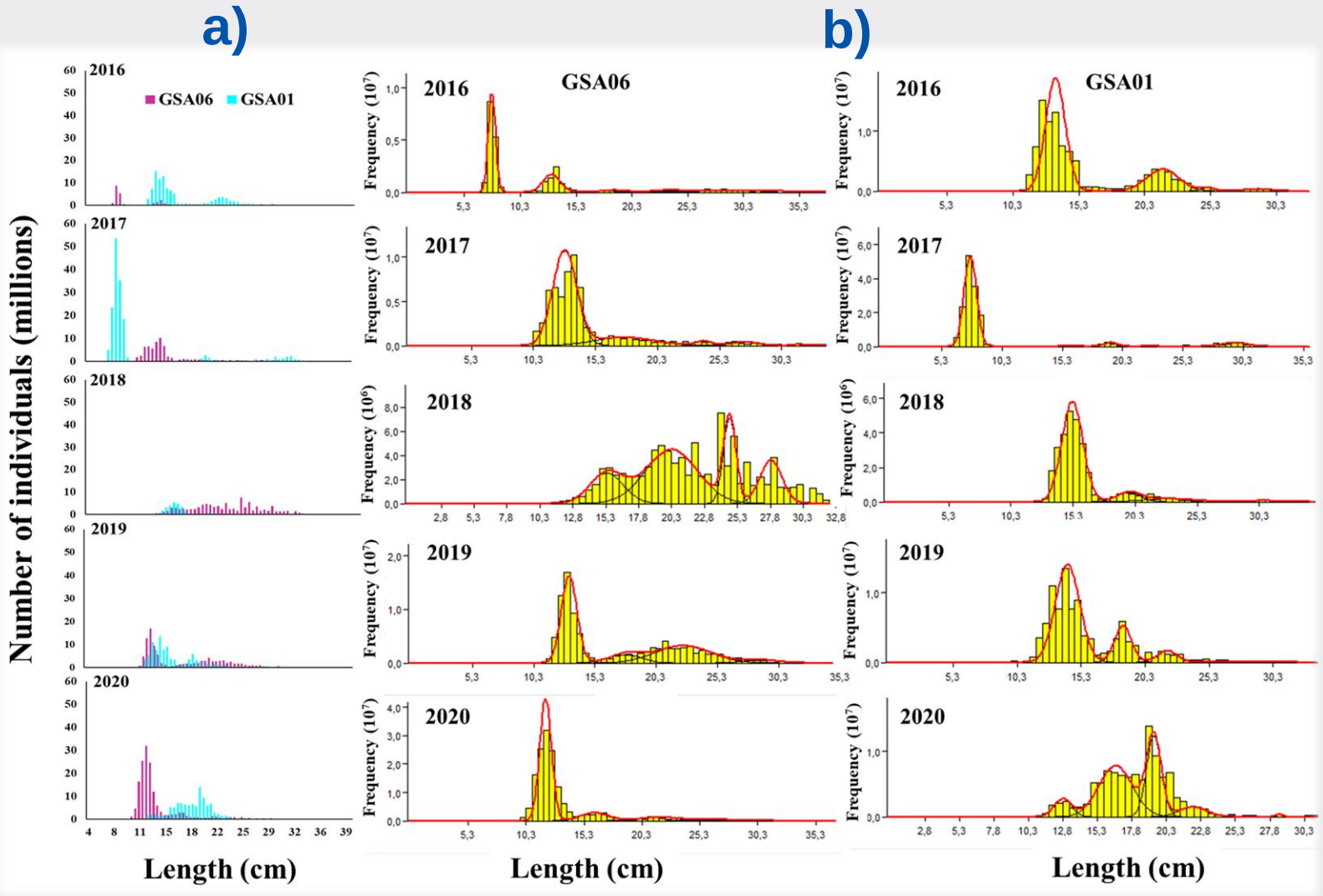


Figure 2. Annual size structure of horse mackerel *T. mediterraneus* by zones (GSA06 and GSA01). a) Frequency of standardized sizes and b) Frequency of non-standardized sizes.

From 4 to 42.5 cm in total length

- Two, three or four modal classes

First year class (age 0)

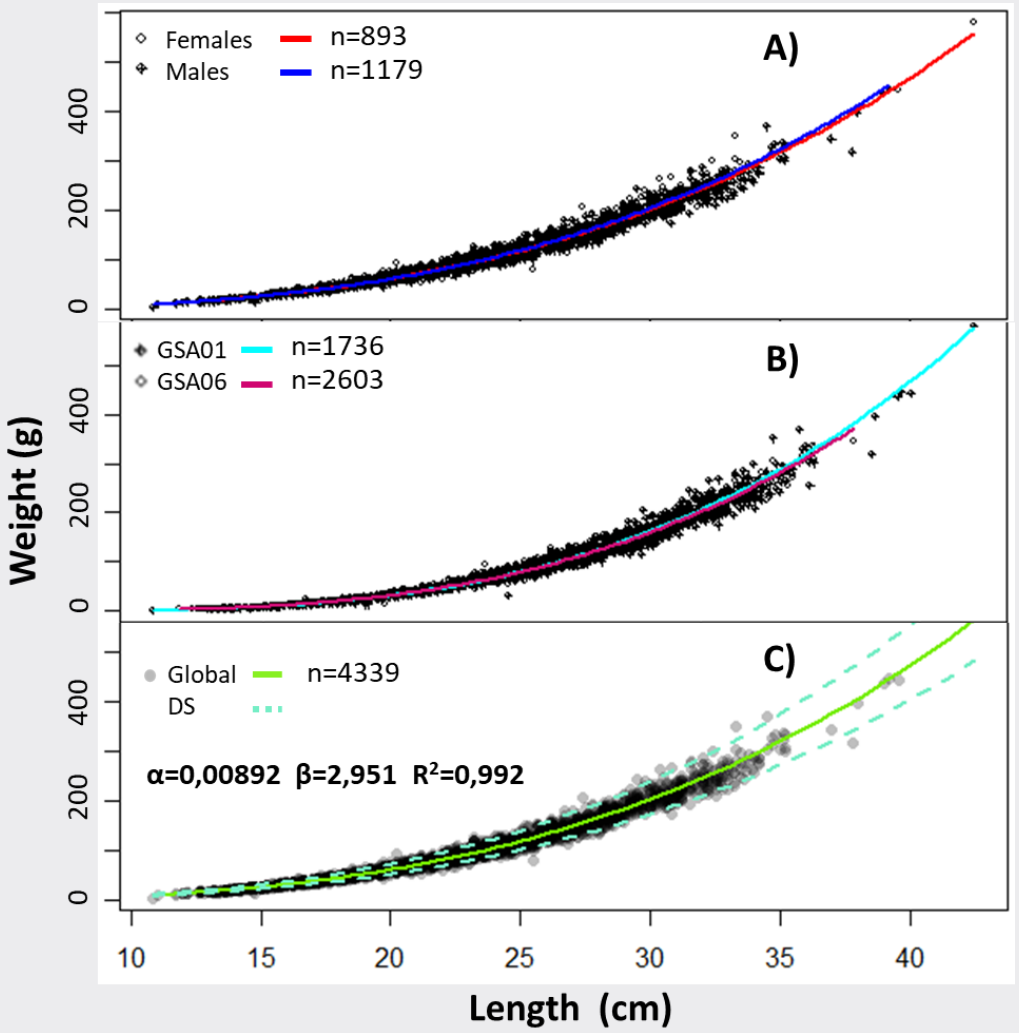
GSA01
2017

GSA06
2016

Significant differences between GSA ($p<0.05$)

GSA01 > GSA06

Length-weight relationship



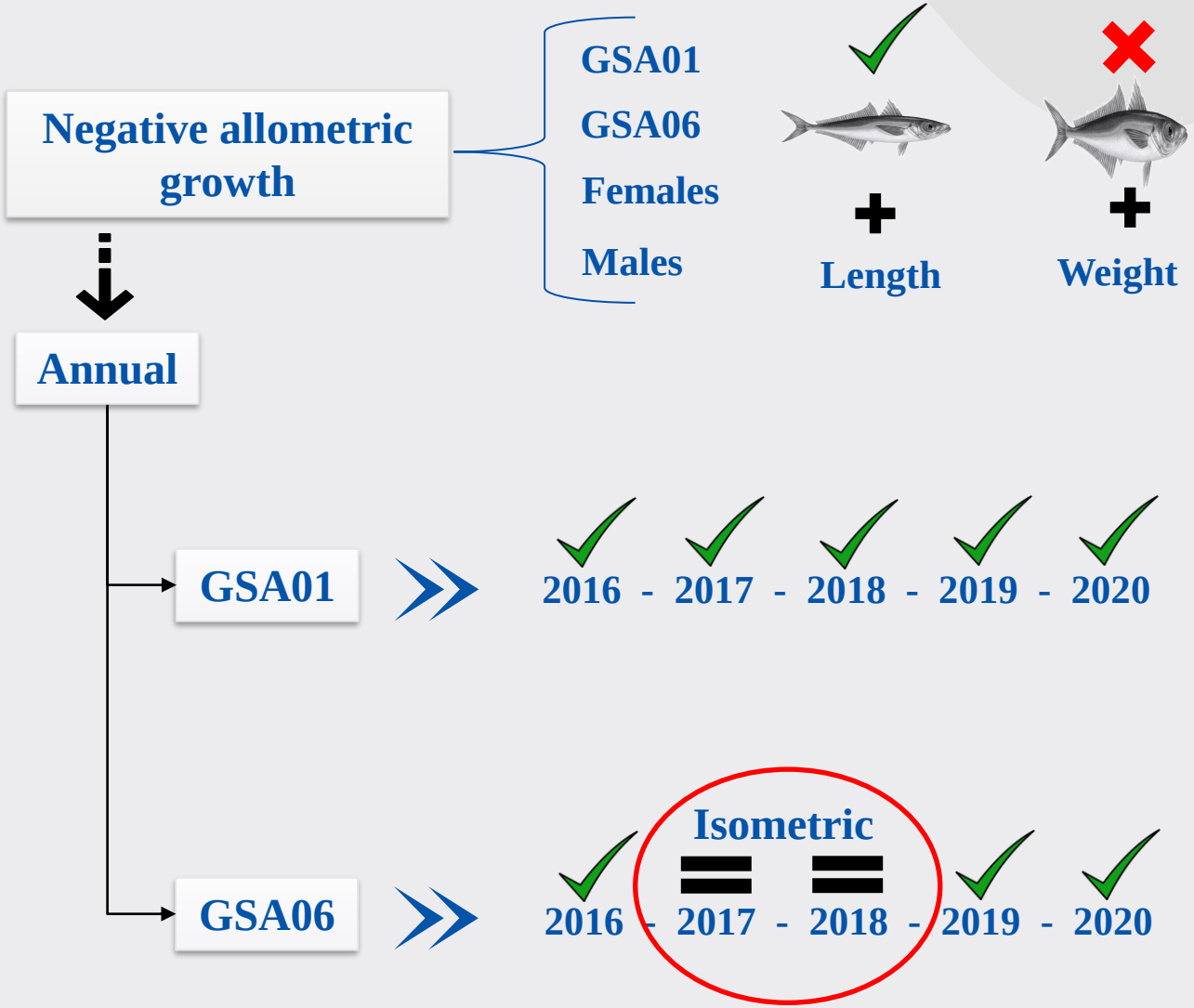


Figure 3. General potential relationship between length and average weight.

Condition factor (CF)

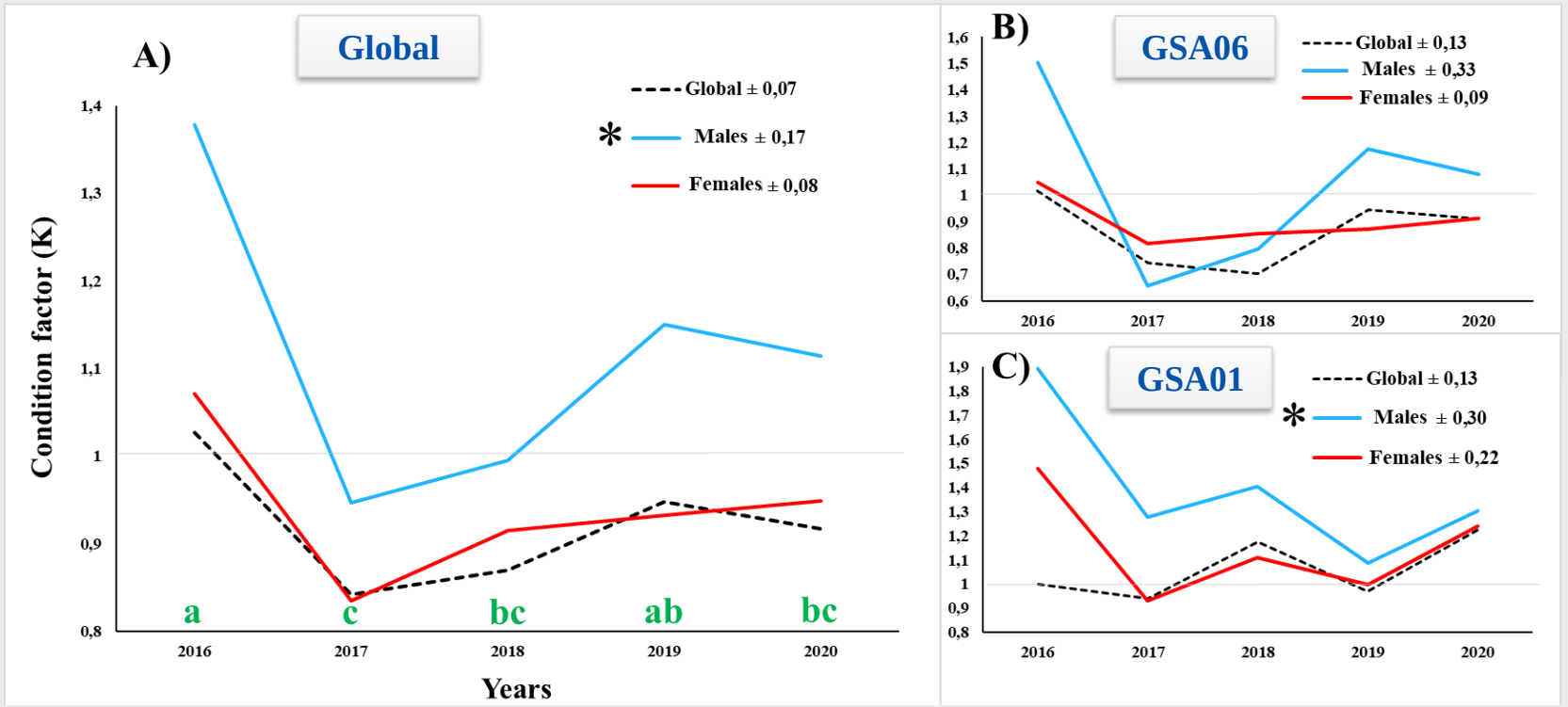


Figure 4. Annual global variation of the condition factor of *Trachurus mediterraneus* in the Spanish Mediterranean.

Global

Years (p<0.0001)

(2016)
K= 1.02 ± 0.07

(2017)
K=0.84 ± 0.06

Sexes (p<0.0001)

Males
K=1.12 ± 0.17

Females
K=0.94 ± 0.08

GSA01
K=1.06 ± 0.13

(p<0.0001)

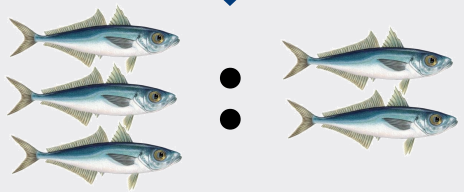
GSA06
K=0.86 ± 0.13

Sex ratio

Table 1. Variation of the sexual proportion of *T. mediterraneus* during the study period and areas. M: Males; F: Females

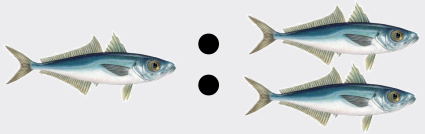
	GLOBAL			GSA06			GSA01		
Year	**F:M**	***χ2***	***P*-value**	**F:M**	***χ2***	***P*-value**	**F:M**	***χ2***	***P*-value**
2016	**0,95:1**	0,21	0,646*	**1,88:1**	16,24	**<0,0001**	**0,65:1**	13,85	0,0002
2017	**0,76:1**	8,43	0,0036	**0,75:1**	7,51	0,0061	**0,82:1**	1,09	0,2965*
2018	**0,72:1**	19,13	**<0,0001**	**0,83:1**	3,45	0,0631*	**0,60:1**	19,50	**<0,0001**
2019	**0,65:1**	35,22	**<0,0001**	**0,63:1**	23,31	**<0,0001**	**0,67:1**	31,00	**<0,0001**
2020	**0,65:1**	39,58	**<0,0001**	**0,64:1**	32,00	**<0,0001**	**0,63:1**	11,97	0,0005

General → **Relationships were similar during the study period and areas**



1M:0.72F ($\chi2 = 92.01$; $p<0.001$)

Exception → **1M:1.88F** ≫ **GSA06 in 2016**



1:1 ≫ **Global in 2016 - GSA06 in 2018 – GSA01 in 2017**

Size at first maturity (L_{50})

($p<0.05$)

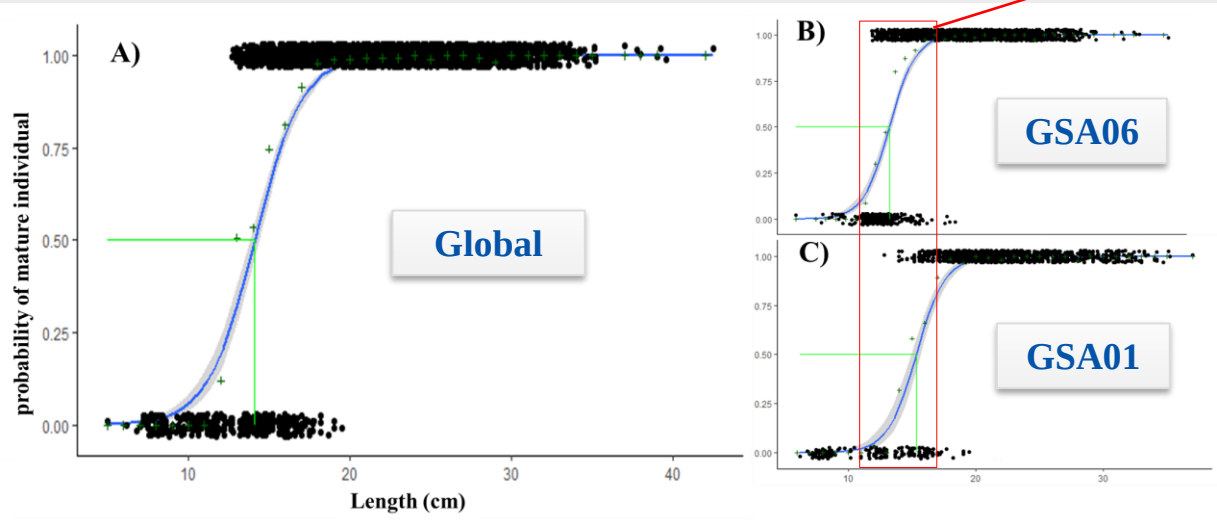


Figure 9. Logistic model of the first size of sexual maturity (L_{50})

Table 2. Periodic variation of the first sexual maturity size (L50)

Year	GLOBAL (cm)	D^2 (%)	GSA06 (cm)	D^2 (%)	GSA01 (cm)	D^2 (%)
2016	15,77	69,9	15,09	75,7	16,00	78,7
2017	15,14	77,7	15,82	80,5	16,40	85,3
2018	13,57	30,8	13,81	33,3	15,51	60,2
2019	14,53	61,9	14,70	62,9	15,71	83,5
2020	13,11	28,8	13,17	38,7	12,16	11,9

Global → L_{50} 14,11 cm (D^2 =58%)

		Mature interval	
		Females ↔ Males	Immature maximun
GSA01	L_{50} 15,34 cm (D^2=61%)	14 - 42,5 cm	12,8 - 37 cm / 19,6 cm
GSA06	L_{50} 14,4 (D^2=49%)	13,2 - 39,5 cm	12,6 - 39,2 cm / 19,2 cm

DISCUSSION

LFD

Melnikova (2019) and Kutsyn (2021)

From 6 to 22 cm in standard length

Ragonese et al. (2002)

- Three modal classes and a possible fourth
- Juvenile recruits of 8 cm

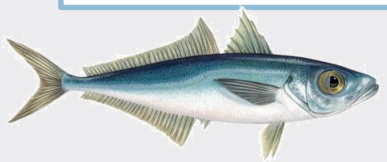
Ventero et al. (2017)

- *Engraulis encrasicolus*
- Larger populations of age 0 and 1 in GSA01 compared to GSA06

- Meta-populations from different localities
- R-type strategists

Cuscó (2015)

GSA01 > GSA06



- Higher primary production and chlorophyll in GSA01
- Favorable environmental conditions

L-W

Ak et al. (2009), Satılmış et al. (2014), Özdemir et al. (2015) and Melnikova (2019)

- β coefficient differs ≠
  - Positive allometric growth

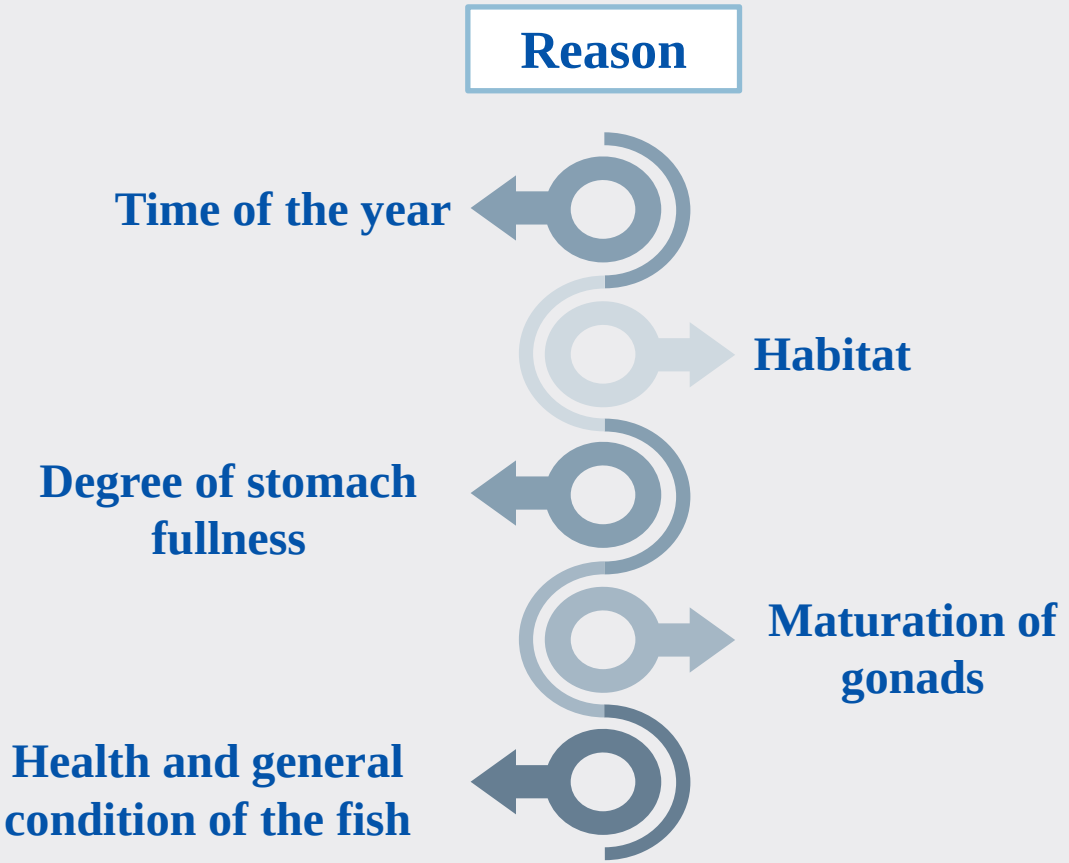
Prodanov et al. (1997) and Yankova et al. (2010)

- Negative allometric growth ✓

Tzikas et al. (2007)

Reported β values between 2.9 and 3, suggesting variations in growth over the months and years ✓

Observed differences could be due to sampling procedure, sample size, length range or environmental factors.



(Froese 2006; Yankova et al. 2010)

CF

Šantić et al. (2011) ≠

- Status lower for males and females
- K<1

Male > Female

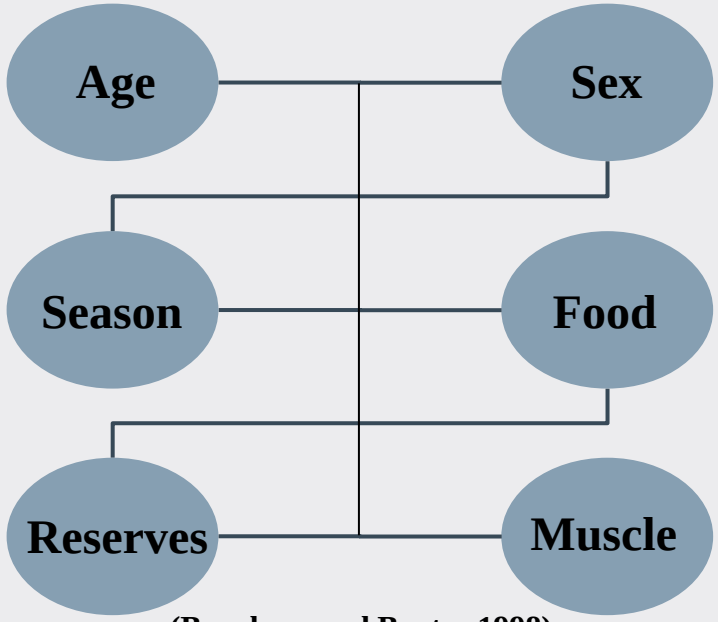
Females invest substantially more energy in reproductive development than males

(King 1995)

Cuscó (2015) ✓

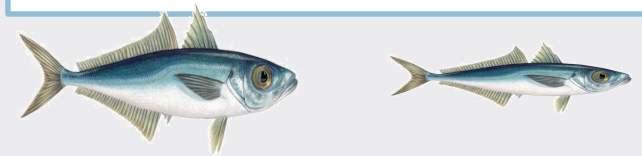
Various authors use the value 3 as the power in the equation for calculating the condition factor, making comparisons difficult

General nutritional state



(Barnham and Baxter 1998)

GSA01 > GSA06



Consequently, variations between zones may be influenced by the effects of coastal upwelling in the region, adverse conditions or food availability

(Ambriz-Arreola et al. 2012)

Sex ratio

Melnikova (2019)

- Males generally dominant over females

Meléndez-Vallejo et al. (2017) and Yankova et al. (2010a)

- Females dominated over males

Carrillo (1978), Raykov and Yankova (2005), Yankova et al. (2010b) and Kutsyn (2021)

- Obtained a 1:1 ratio

The sex ratio tends to be 1:1 between males and females

- Varies from year to year within the same population
- Reproduction period

The sampling time coincides with the reproduction of the species

Variation in the proportion of females and males may be due to physiological factors during spawning. Furthermore, in some cases males may be more vulnerable to the art than females

L_{50}

Samia et al. (2002)

- Northern Tunisia, Africa, with 15.7 cm

Demirel and Yuksek (2013) ≠

- Mamara Sea 12.2 and 12.5 cm

Ak et al. (2015) ≠

- Black Sea 11.52 and 11.97 cm

- Stock difference
  - Fishing pressure
    - Phylogenetic, morphological and genetic characteristics

(Turan 2004; Bektas and Belduz 2008)

Global L_{50} 14.11 cm

- Proposal of **Ventero et al. (2017)**

GSA01 ≠ **GSA06**

Using the sizes of the models that managed to explain the greater variability

GSA01	GSA06
16.40 cm	15.82 cm

The model is determined by the set of mature and immature individuals analyzed during the study

(Leal et al. 2013)

CONCLUSIONS

- The LFDs showed significant differences in length according to age, suggesting that *T. mediterraneus* presents a greater length in GSA01 compared to GSA06, possibly favored by a greater availability of food.

- *T. mediterraneus* showed negative allometric growth with some isometric type oscillations in GSA06 due to its condition status.

- *T. mediterraneus* presented a better condition status in GSA01 than in GSA06. In addition, in this area the males presented a better condition than the females, which invest their energy in spawning.

- The sex ratio did not respond to the expected 1: 1. Males predominated over females, probably due to physiological factors during reproduction.

- The selection of the L50 was based on the most precise model, in which significant differences were detected between the GSAs, suggesting the use of 16.40 cm in GSA01 and 15.82 cm in GS06 as sizes at first maturity to establish sizes at first catch as part of the future management of this resource in the Mediterranean Sea.

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Thank Balearic Oceanographic Centre (COB)

Thank you for your attention