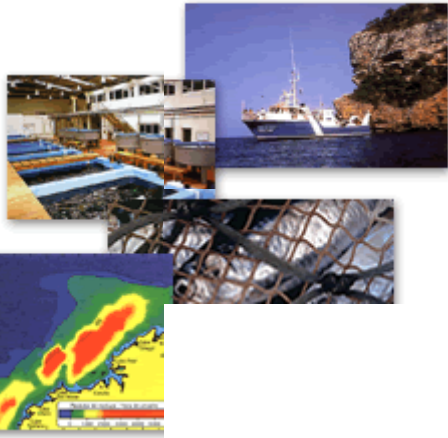




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GULF OF CADIZ CHUB MACKEREL. AVAILABLE BIOLOGICAL INFORMATION FROM SPANISH WATERS

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ICES Workshop on Atlantic
chub mackerel (*Scomber
colias*), WKCOLIAS.
Santa Cruz de Tenerife,
13-17/01/2020





- **Rodríguez-Roda, J. (1982)**: first work reporting biological information on the species in the Gulf of Cadiz (GoC) Spanish waters.
 - Scattered monthly commercial (purse-seine) samples in 1977-1978 (672 specimens).
 - Individual biological sampling: TL, FL, TW, EW, Cond. Factor (K), Sex, Mat. Stage, Mesenteric fat, Stomach repletion, #1D-Rays, Otoliths (222 indiv. subset).
 - **Metric relationships and LFDs based on fork length (FL).**
 - Gaps of information prevented from defining the spawning season and the L_{m50} . Assumptions based on indirect evidences.
 - Spawning season: **probable winter peak spawning** from low K values, but also a **protracted spawning season** from the consecutive occurrence of small individuals throughout March-June.
 - **¿ $L_{m50} > 306$ mm FL?** (from the observed range of maturing specimens).
 - Age and growth:
 - Age readings, otol. edge monitoring, otol. measurements (OTL & ORL vs FL).
 - Mean FL at age: Age 0 (20.6 cm FL), Age 1 (22.4 cm FL), Age 2 (26.4 cm FL).
 - No VBGF fitted (very few age groups).
 - **Fishery mainly supported by juveniles (age groups 0 and 1).**
 - **Growth similar to the NW African populations** (from comparison of mean FL-at-age in other populations).



- **CREANDA project (2003-2005)**: Study on the biological parameters (growth and reproduction) of several species of fisheries interest in the GoC and Alborán Sea (Alb) Spanish waters.
 - **GoC vs Alborán Sea (Alb)**. October 2003-October 2004. Monthly comm. & res. surv. samples.
 - Spp: caramote prawn, rose shrimp, sardine, anchovy, horse mack., **chub mack.**, hake, stripped red mullet, axillary seabream, common sole.
 - Individual biological sampling: TL, TW, EW, GW (GSI), Sex (Sex Ratio), Mat. Stage (Microscopical scale), Fecundity, Otoliths (221 indiv. subset).
 - Biometrics:
 - **GoC fish larger and heavier (28.6 cm, 241 g) than Alb fish (26.6, 168 g).**
 - Maturity and Reproduction:
 - Sampled specimens through the study period either immature or maturing in both areas.
 - » **Spawning season not clearly defined (winter - early spring).**
 - » **L_{m50} not estimated (only in Alb males: 27.2 cm).**
 - Age and Growth (age reading, edge monitoring, otolith meas. (OTL; back-calculation), VBGF (FISAT II)): see next slide (Velasco *et al.*, 2011 paper) .



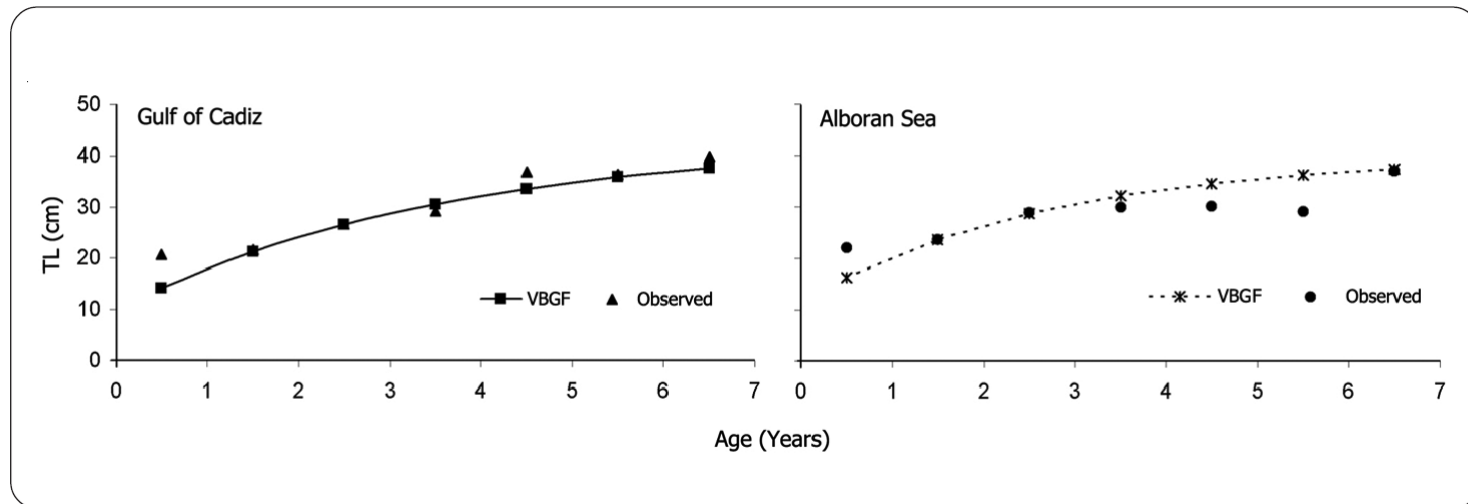
- **Velasco *et al.* (2011)**: Comparative study on age and growth of chub mackerel off Spanish GoC and Alborán Sea.
 - Age and Growth (age reading, edge monitoring, otolith meas. (OTL; back-calculation), VBGF (FISAT II): 221 otoliths.
 - Relative growth (LWR): no difference between sexes nor between areas.
 - Age structure: **GoC: 0-VII**; Alb: 0-VI.

Table 1. Length and age correspondence of the chub mackerel *Scomber colias* in two sampling areas. 0 to VII indicate the fish age in years / Correspondencia entre longitud y edad del estornino *Scomber colias* en dos áreas de estudio. 0 a VII indica la edad de los peces en años

Length (cm)	Age classes															
	Gulf of Cadiz							Alboran Sea								
	0	I	II	III	IV	V	VI	VII	0	I	II	III	IV	V	VI	
16.0-16.9		2														
17.0-17.9		7								8						
18.0-18.9	1	4								4						
19.0-19.9	2	5								2						
20.0-20.9	4	6	1						1	1						
21.0-21.9		7	1						1	1	1					
22.0-22.9		2	1	1						2	1					
23.0-23.9	1	3	4	1					1	1	1					
24.0-24.9	1	4	2	1						2						
25.0-25.9		2	4							3	2			1		
26.0-26.9			4	1						6	6	1				
27.0-27.9		3	5	2						2	4					
28.0-28.9		1	5	1							6	1				
29.0-29.9		2	3	3						1	8				1	
30.0-30.9			5	3						3	6					
31.0-30.9										1	6	1				
32.0-32.9										1	5					
33.0-33.9		1		3	2						1					
34.0-34.9					1						1	1	1			
35.0-35.9				1										1		
36.0-36.9						1										
37.0-37.9																
38.0-38.9					1			1								
39.0-39.9					3											
40.0-40.9																1
41.0-41.9								1								
42.0-42.9																
43.0-43.9									1							
n	9	49	35	17	7	1	2	1	3	39	48	4	2	1	1	
Mean Length	20.7	21.6	26.7	29.2	36.9	36.4	39.9	43.0	22.0	23.6	28.9	29.9	30.1	29.1	40.0	



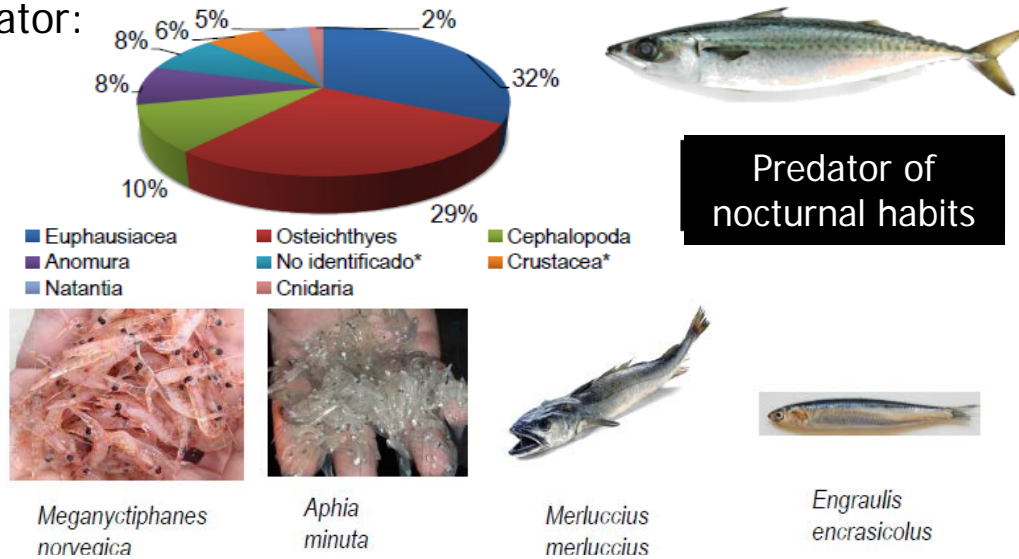
- **Velasco *et al.* (2011)**: Comparative study on age and growth of chub mackerel off Spanish GoC and Alborán Sea.
 - VBGF parameters:
 - » Linf: GoC = 43 cm; Alb = 40 cm.
 - » K: GoC= 0.27; Alb = 0.37.
 - » **No GoC vs Alb growth differences.** "Strait of Gibraltar is not a geographical barrier for the life history of the species".





• **Torres *et al.* (2013)**: GoC food-web structure (Ecopath with Ecosim).

• As a predator:



• As a prey: important food resource for top predators

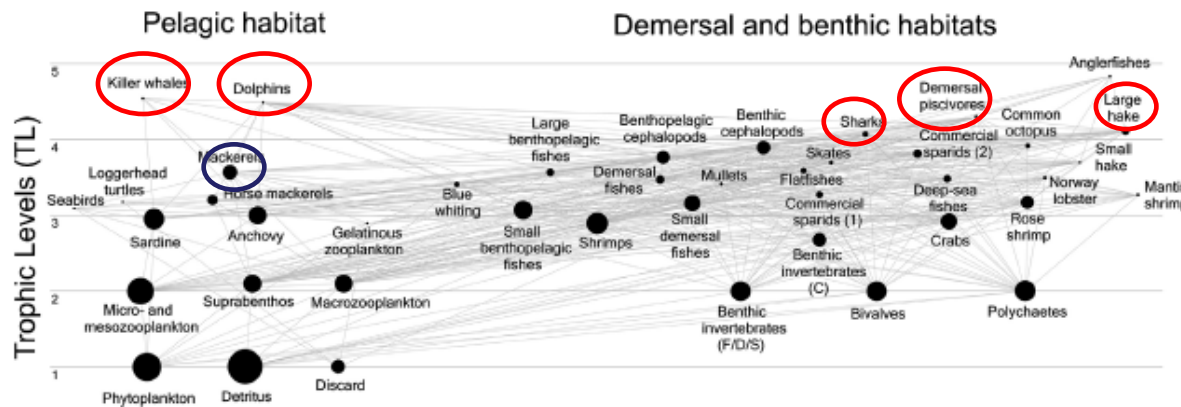
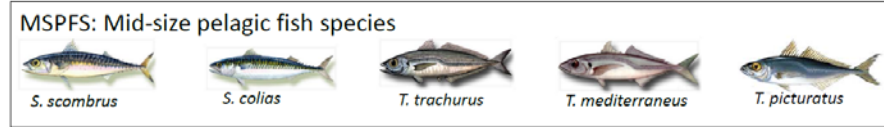


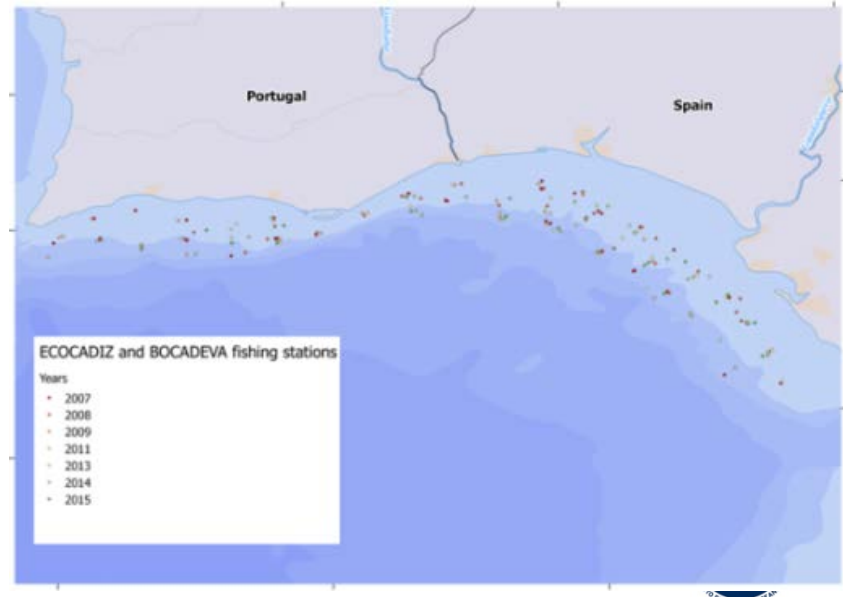
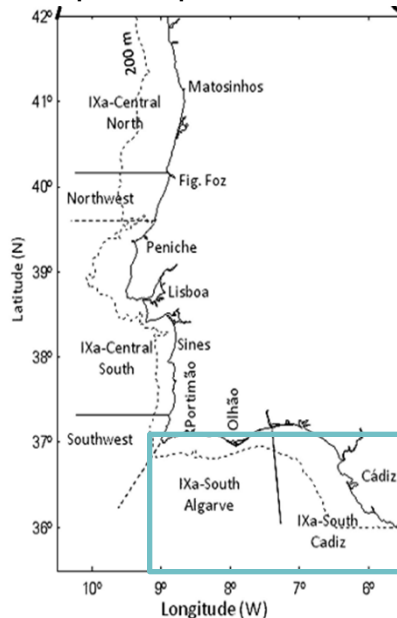
Fig. 3. Flow diagram of the Gulf of Cadiz food web. The size of each circle is proportional to the biomass of the functional group. All the functional groups are represented according to their trophic levels on the y-axis (TL) and connected to each other through light gray lines that represent prey-predator relationships. Groups are organized considering their pelagic, demersal and benthic habitats.



- **Canseco (2016)**: Life history traits (LHTs) and spatial patterns of five mid-size pelagic fish species (MSPFS) of the Gulf of Cadiz.



- MSc Thesis general objective: to provide novel information on LHTs and spatial patterns of 5 MSPFS in the Gulf of Cadiz shelf waters, based on IEO *ECOCADIZ* summer acoustic surveys (2007, 2009, 2013, 2014, 2015) and *BOCADEVA* GoC anchovy depm surveys (2008, 2011).
- Populations' demographic structure: size composition, reproductive and condition status, age structure and growth patterns (Fishing hauls biological data from acoustic & depm surveys).
- Populations' spatial patterns over time to better understand their habitat preferences (NASC data).



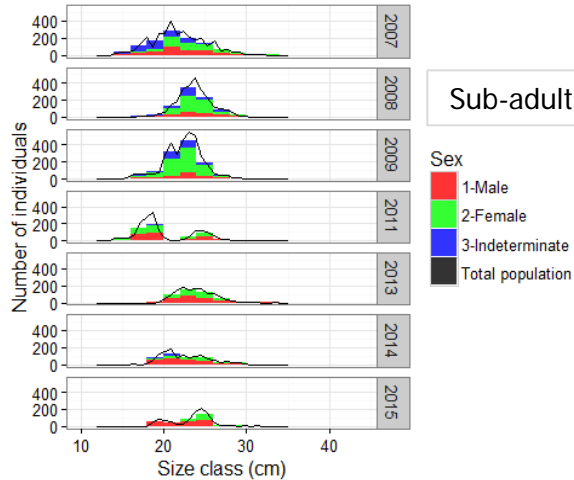


- **Canseco (2016)**: LHTs and spatial patterns of five MSPFS of the GoC.
 - LHTs:
 - Size composition: LFDs.
 - Reproductive status: sex ratio, maturity stage, $L_{m50\%}$.
 - Relative growth & Condition status: LWR, Stomach fullness, Le Cren's relative condit. factor.
 - Age and growth: length frequency analysis (LFA; FiSAT software, Gayanilo *et al.*, 2005).
 - ELEFAN I (Pauly and David, 1981) .
 - Modal Progression Analysis (MPA; Petersen, 1892).
 - » Bhattacharya (1967).
 - » NORMSEP (Abrahamson, 1971).
 - Spatial preferences and patterns (NASC) (in GoC acoustic surveys pptx):
 - Single parameter quotient (SPQ; Van der Lingen *et al.*, 2004). NASC *vs* Depth, Latitude, Longitude.
 - Centre of gravity (mean location), inertia (dispersion) and isotropy (homogeneity) (Bez, 1997).



• **Canseco (2016)**: LHTs and spatial patterns of five MSPFS of the GoC.

Size composition

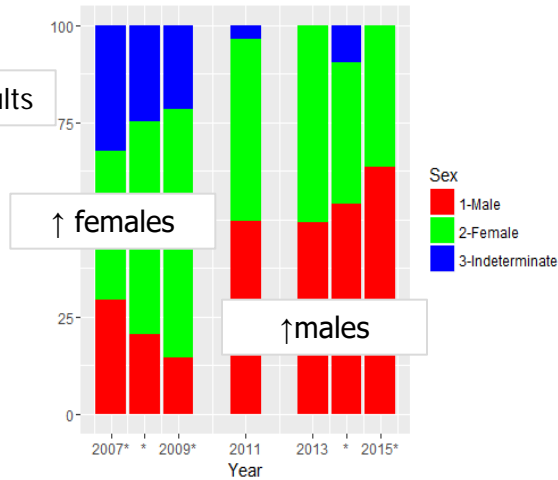


Sub-adults and adults

Sex
 1-Male
 2-Female
 3-Indeterminate
 Total population

Size range (13.0 to 34.6 cm)
 Modal size classes (21.0 and 24.0 cm)
 (Largest: 65 cm; Navarro *et al.*, 2012; GoC)

Reproductive status



LFM: 22 cm – 24.6 cm (< CREANDA Project (2005); Alb males)

Relative growth and condition status

- Positive allometric growth (~ Torres *et al.*, 2012; Velasco *et al.*, 2011; GoC)
- Mean condition factor (0.004)
- Stomach fullness suggests daytime feeding (≠ Torres *et al.*, 2013; GoC).

Age structure and growth determination

MPA:

Age groups=2 to 8, $K=0.14 \text{ year}^{-1}$, $L_{\infty}=51.5$

ELEFAN I:

Age groups=1 to 5, $K=0.40 \text{ year}^{-1}$, $L_{\infty}=39$, $R_n=0.30$

(~ Velasco *et al.*, 2011; GoC)



- **Canseco (2016)**: LHTs and spatial patterns of five MSPFS of the GoC.

- Limitations:

- Spatial and temporal coverage: summer, daytime, 20-200 m. Overall effects in LHTs.
- Maturity stage 1 comprises virgin (immature) and resting (adult) specimens. Undesirable effects in the LFM (overestimation?).
- Questionable reliability of the resulting age structure and VBGF parameters (very mixed LFDs and very long time intervals between samples).



• Concluding remarks on scientific background:

- Spawning season: timing and extension not yet clearly defined. Winter-early spring spawning season? Winter peak spawning? Protracted spawning season?
- ECOCADIZ surveys in summer and ECOCADIZ-RECLUTAS surveys in autumn mainly survey a sub-adult population.
- An incomplete sampling through the year has prevented in previous studies from a consistent estimation of the Length/Age at first maturity. In the GoC Canseco (2016) estimated a Lm50% for both sexes combined ranging between 22 and 24.6 cm, but with a possible overestimation. However, Rodríguez-Roda (1982) considered that Lm50% should be larger than 30.6 cm FL.
- Age structure: variable depending on the study: Age 0 – Age 2 (Rodríguez-Roda, 1982; fishery, otol.); Age 0 – Age 7 (Velasco *et al.*, 2011; fishery, otol.); Age 2 – Age 8 (Canseco, 2016; population in summer, LFA-MPA); Age 1 – Age 5 (Canseco, 2016; population in summer, LFA-ELEFAN I).
- Fishery (in the 80's...and now) mainly supported by juveniles & sub-adults (Age 0, Age 1).
- Growth: similar between NW Africa-GoC-Alborán. But VBGF parameters estimates different depending on the study.
- Important role in the GoC food web: important food source for top predators. In GoC Spanish waters mainly predate on euphausiaceans, transparent goby, small hake and anchovy.



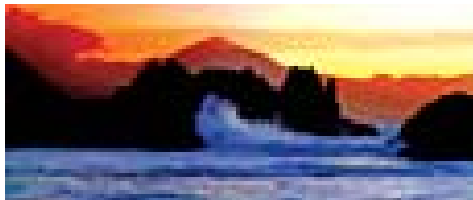
• IEO's biological sampling programme (2019 on):

- Biological data are also available either since 2007 (ECOCADIZ acoustic & BOCADEVA anchovy DEPM surveys) or 2012 (ECOCADIZ-RECLUTAS acoustic surveys). Age structure available but using 8c9aN ALKs (surveys ALKs since 2009 on).
- **Monthly commercial samples** (complemented with surveys samples) **since 2019 on**.
 - \approx 100 individuals/sample.
 - Individual variables as usual with otolith extraction.
 - No age reader at Cádiz. Age readings by "Assessment" reader at Santander lab.
 - 2019 biological information not yet analyzed:
 - Quarterly LWR.
 - Quarterly LFDs of landings, discards and catches (observers at sea programme).
 - Own Quarterly ALKs.
 - Quarterly Catch-at-age.
 - Quarterly Weight-at-age in catches
 - Weight-at-age in the stock.
 - Spawning season.
 - Length- and Age at Maturity ojives.

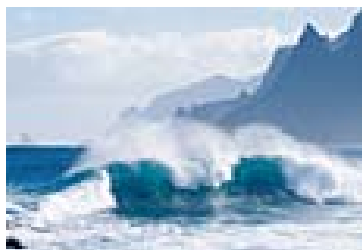
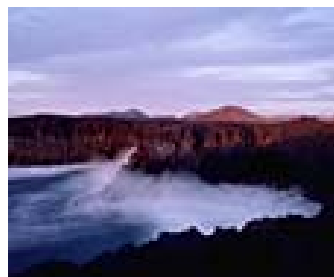
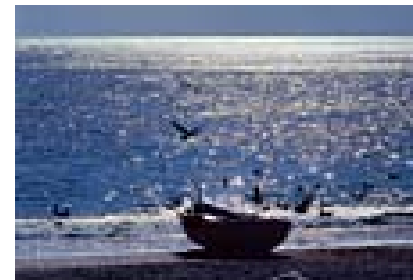
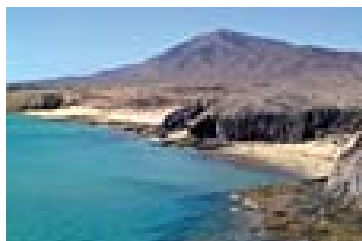
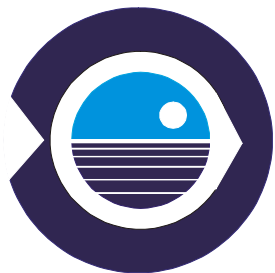


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Thanks



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