

Vulnerability of small pelagic fish populations in non-upwelling areas under climate change.

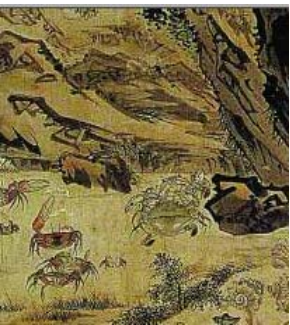


David Costalago & Isabel Palomera,
Institute of Marine Sciences-CSIC, Barcelona (Spain).

2nd International Symposium

Effects of Climate Change on the World's Oceans.

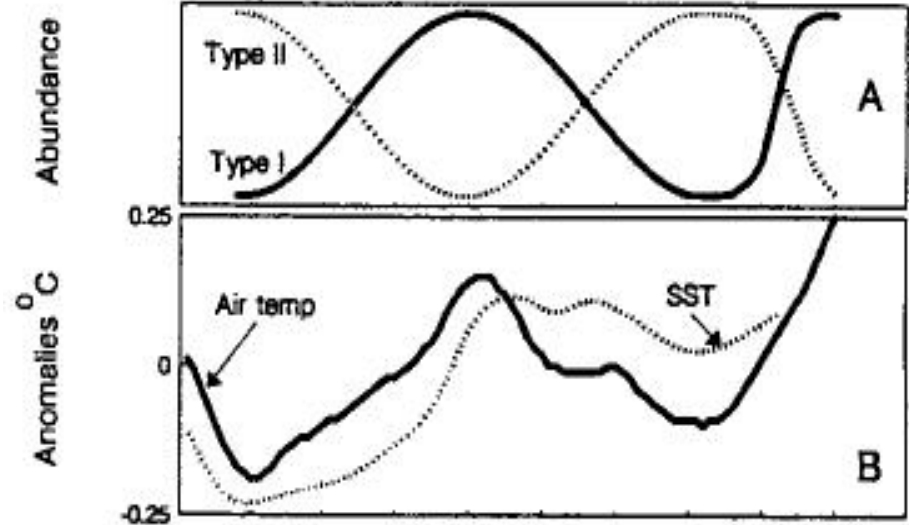
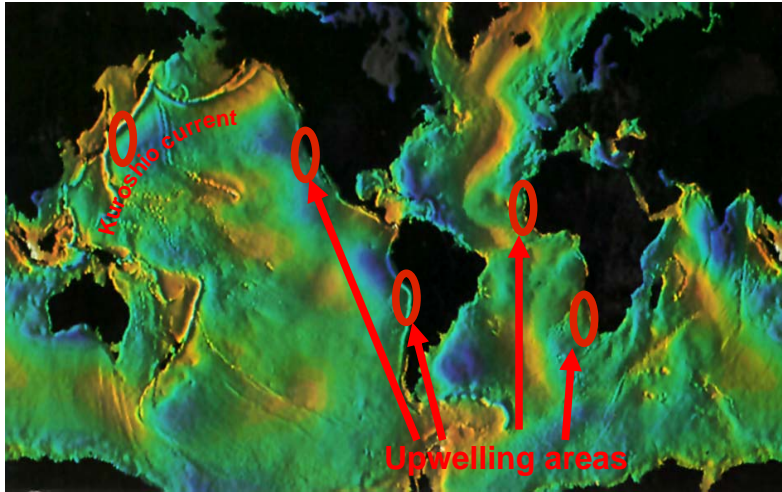
Yeosu, Korea. 13th - 20th May 2012.



OUTLINE

- **Anchovy and sardine in the world's oceans.**
- **Anchovy and sardine in the Mediterranean sea.**
- **Diet overlap and ontogeny of juveniles.**
- **Diet of larvae.**
- **Nutritional condition of anchovy larvae.**
- **Conclusions.**

Anchovy and sardine in the world's oceans.

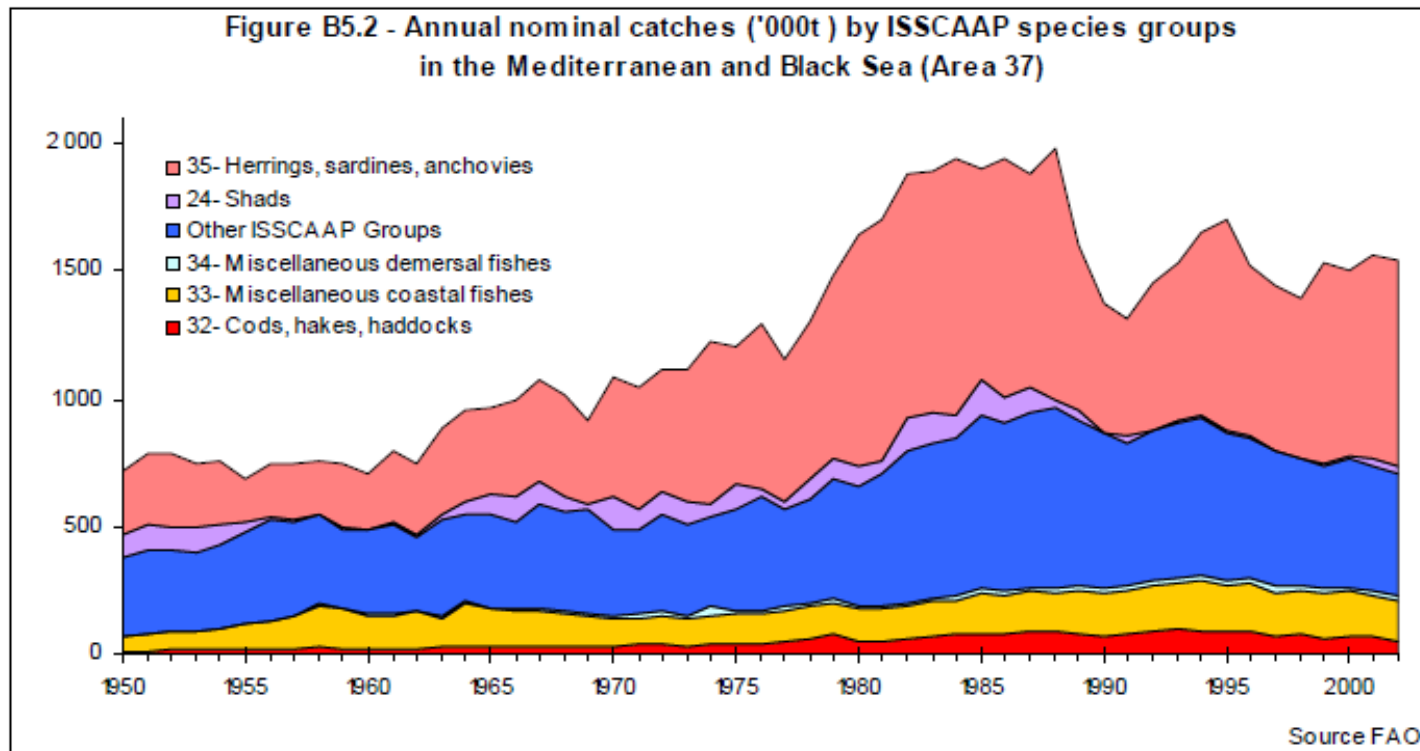
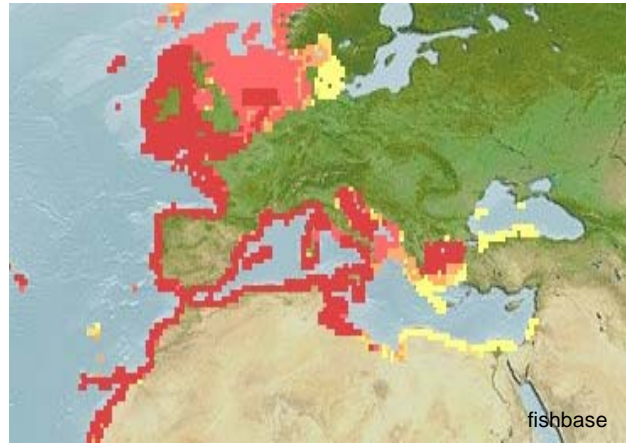
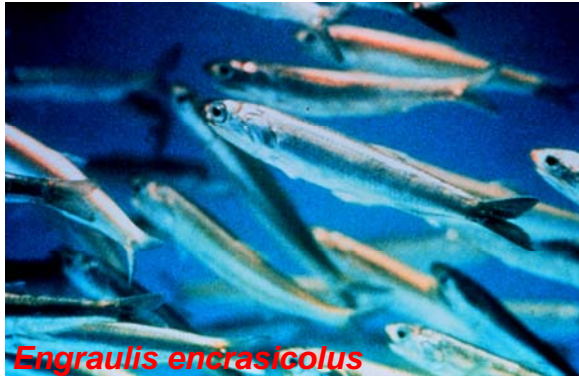


Lluch-Belda *et al.* 1992. *Fisheries Oceanography* 1:4.

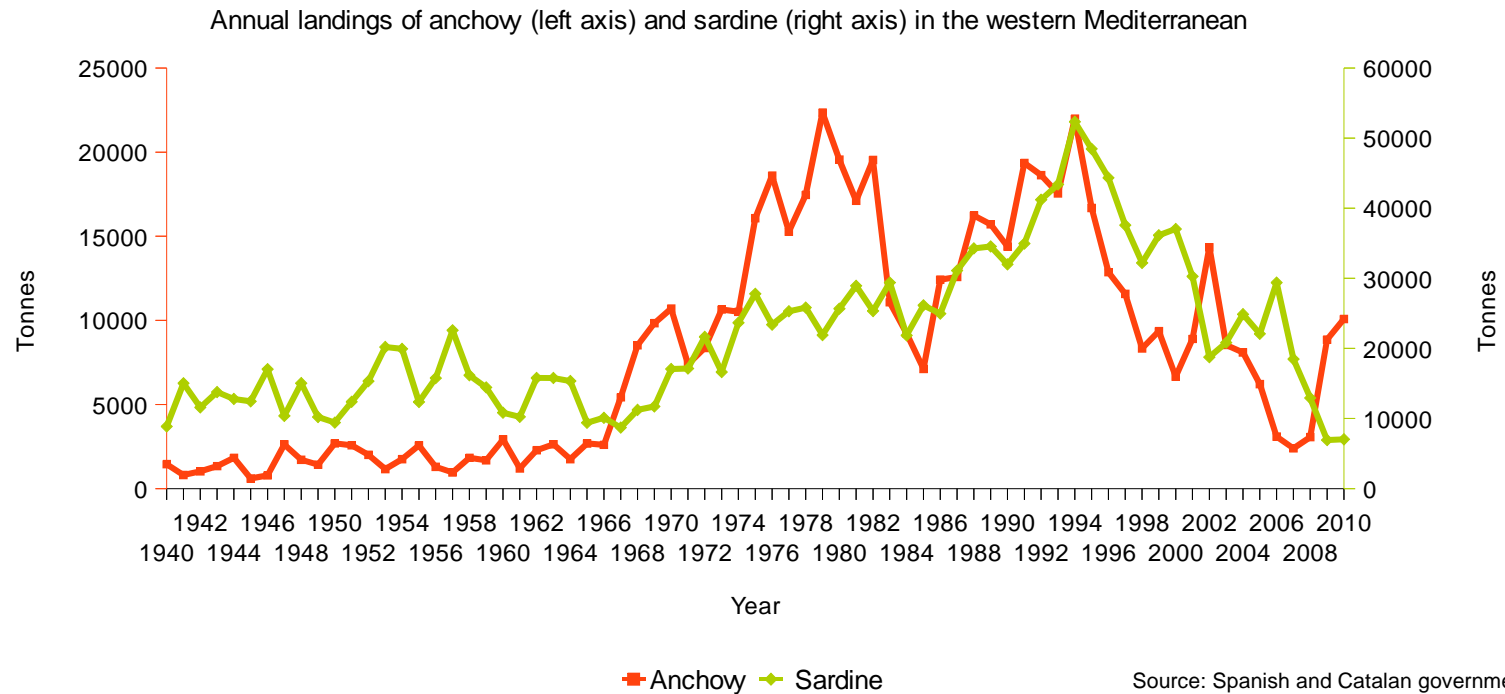
Species alternations between Anchovy and Sardine may be trophodynamically-mediated ([Van der Lingen *et al.* 2006. African Journal of Marine Science 28](#)).

The subdominant species, least exploited, may initiate a recovery while the other species is still abundant, and later dominates the forage-fish community ([Schwartzlose *et al.* 1999. South African Journal of Marine Science 21](#)).

Anchovy and sardine in the Mediterranean.



... but there is **no species alternation in the western Mediterranean** (Martín et al. 2011. *Climatic Change* 110)

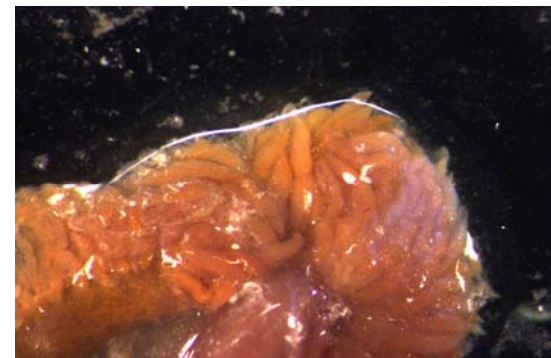
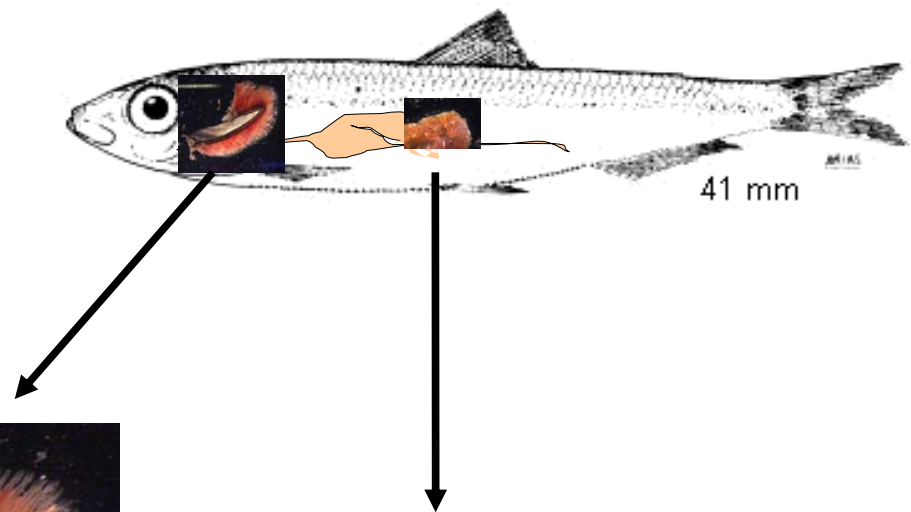
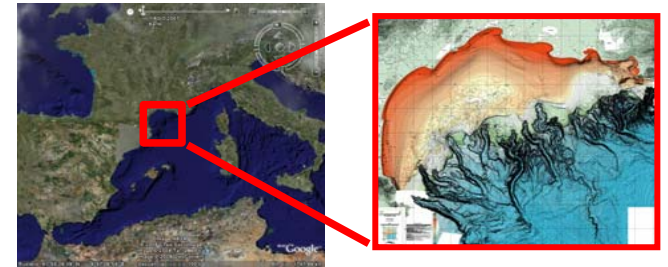


- Is the lack of alternations **also trophodynamically mediated?**
- If so, what can be the **consequences** for the populations **under** the current **changing environment and fishing pressure?**

Diet overlap and ontogenetical development of juveniles

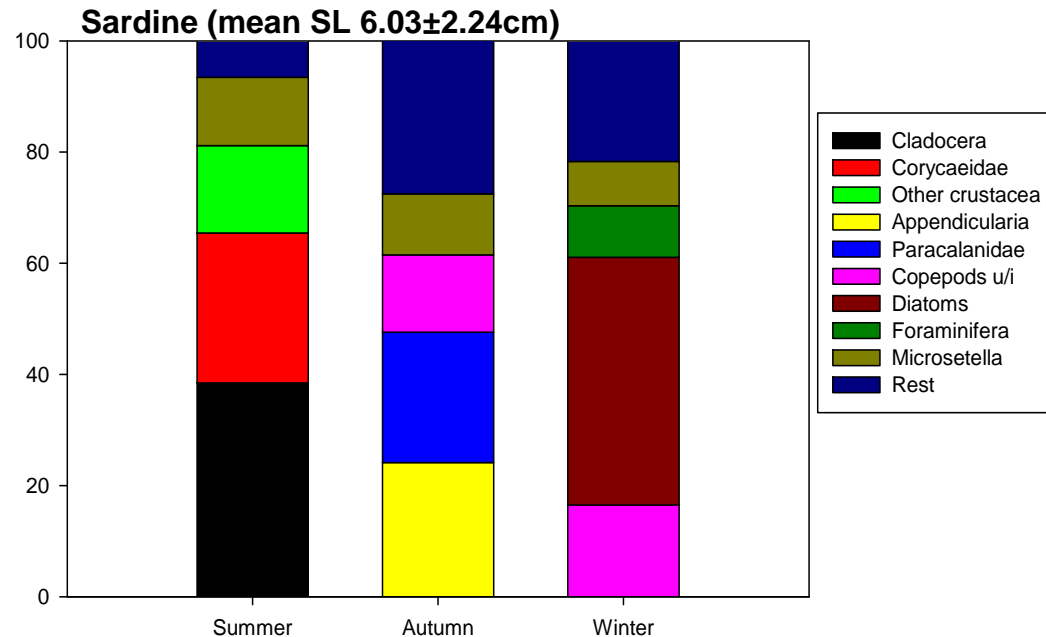
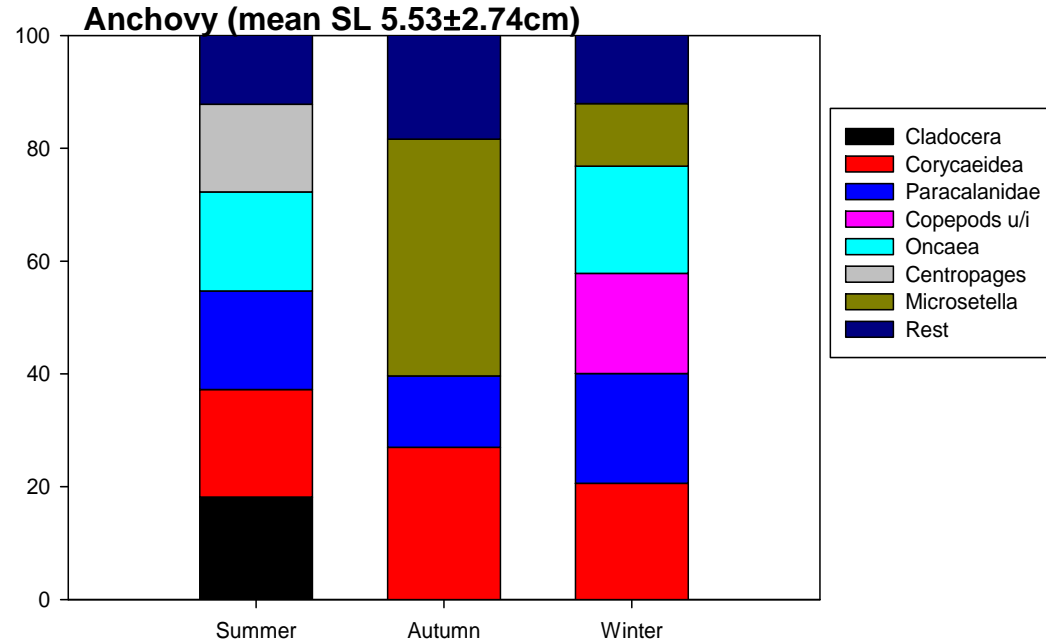
Methodology

- Analysis of stomach contents.
- Measurement of ontogenetical parameters,
 - number of pyloric caeca (PC)
 - number of gill rakers (GR)
 - length of GR
 - GR gap



Diet overlap and ontogenetical development of juveniles: Results.

Diet composition



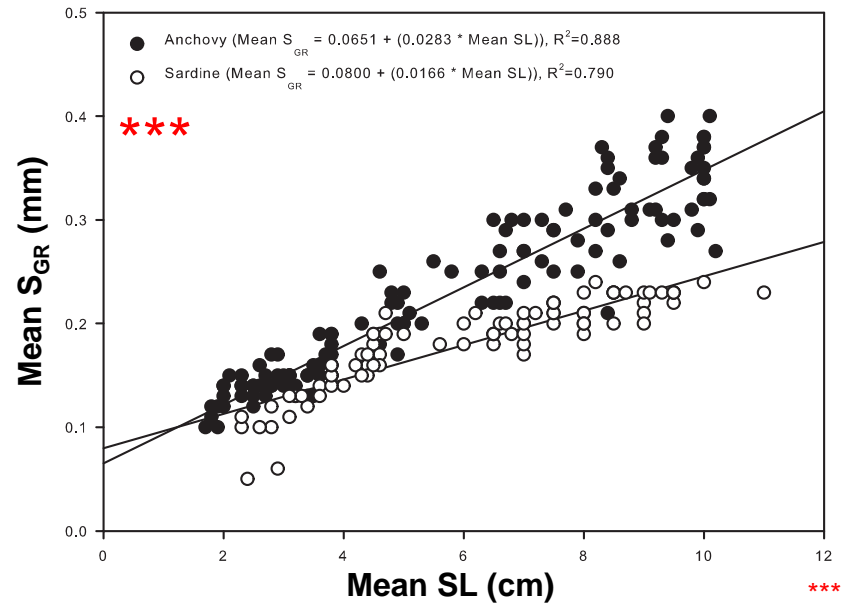
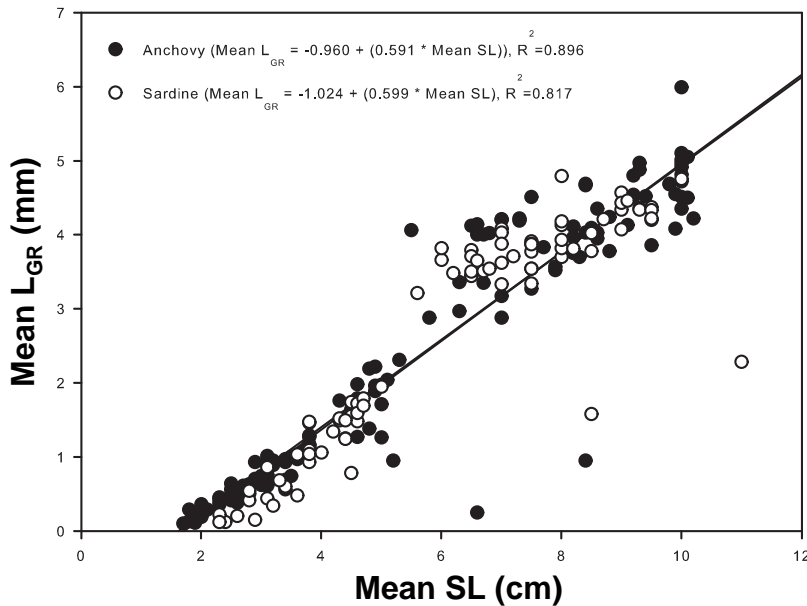
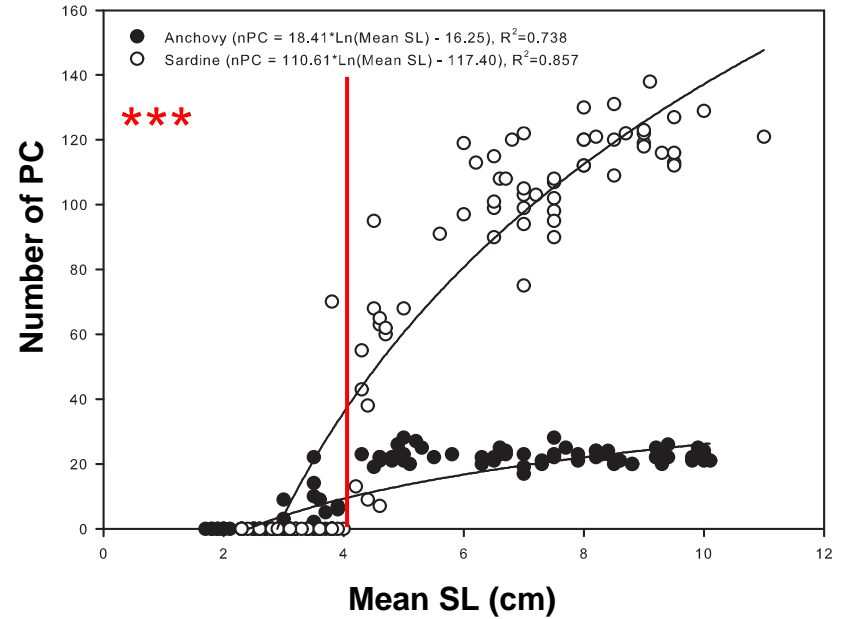
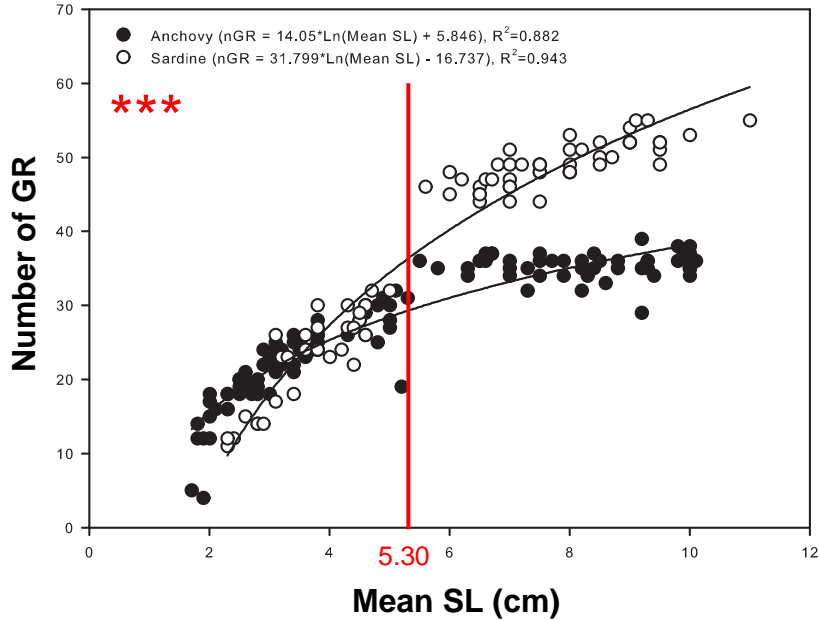
No diet overlap

summer: D=0.40;

autumn: D=0.33;

winter: D=0.28.

Ontogenetical development of juveniles

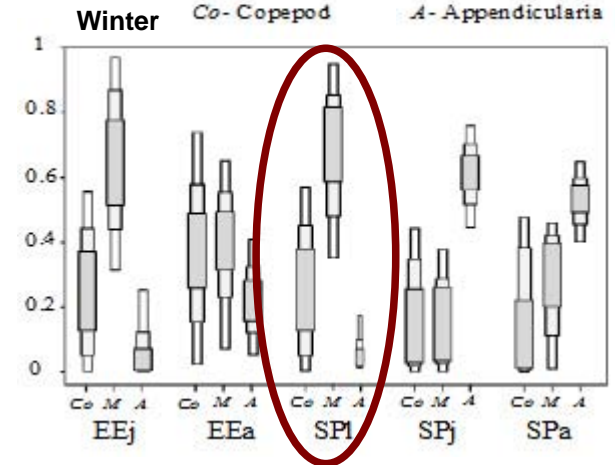
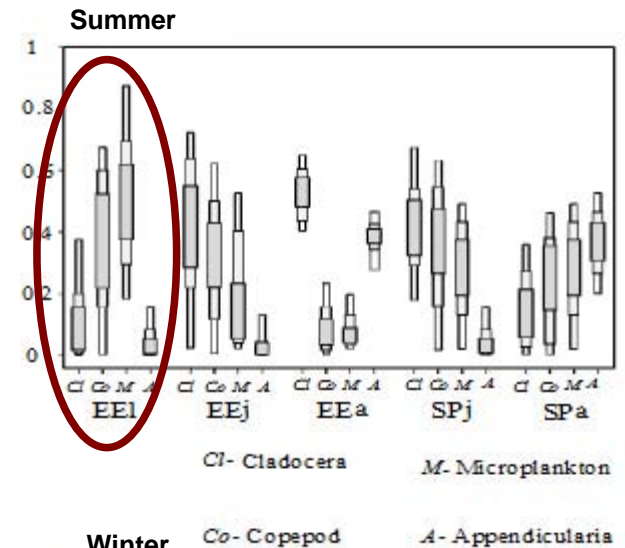
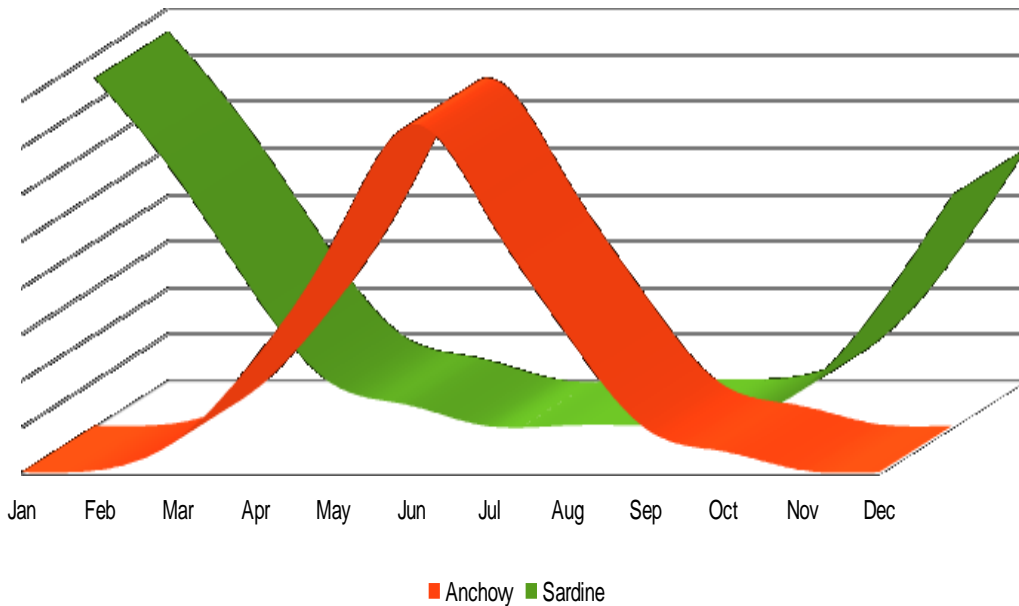


*** $p < 0.001$

Diet of larvae

Only larvae are likely to show interspecific diet overlap.

However, the spawning periods of anchovy and sardine do not coincide...

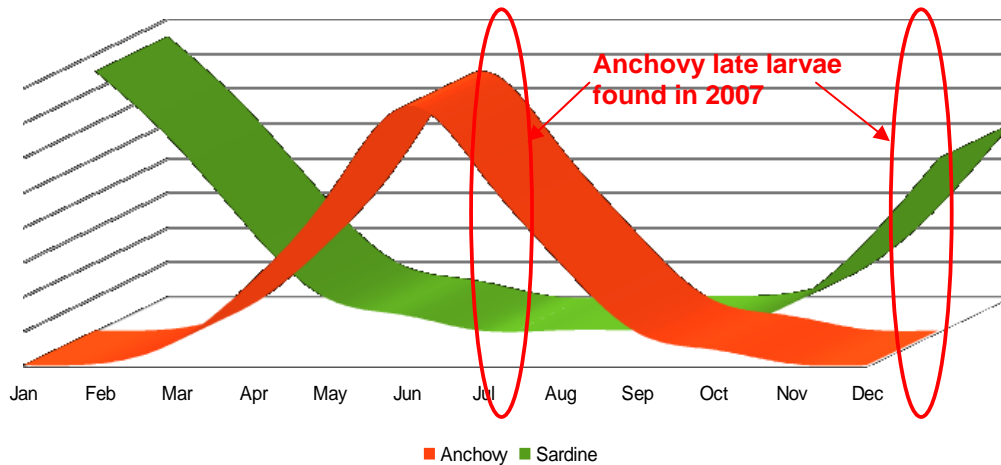


Costalago *et al.* 2012. *Marine Ecology Progress Series*, *in press*.

until now?

Spawning periods

(Late larvae > 15mm standard length.)



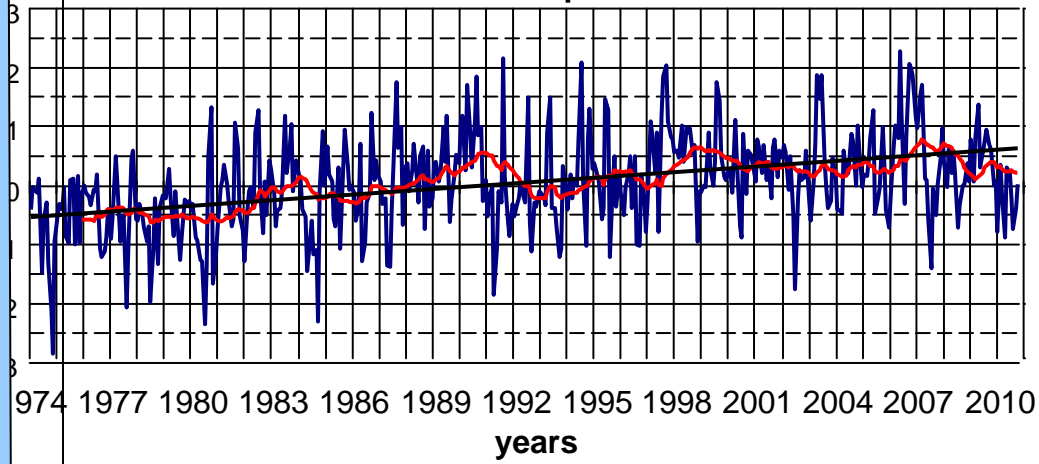
Condition of anchovy larvae

Table 1

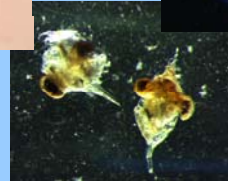
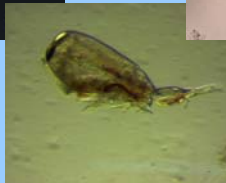
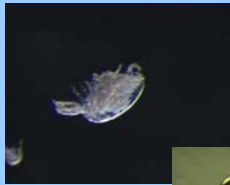
Total lipid content, lipid class values and TAG/CHOL index ($\mu\text{g} \cdot \text{larva}^{-1}$), presented as Mean \pm SD.

	August 2007 (N = 7 pools of 4–6 larvae each)	December 2007 (N = 5 pools of 4–5 larvae each)
Total lipid content	770.4 \pm 275.1	664.5 \pm 92.7
% lipid/dry weight	4.2 \pm 0.8	4.4 \pm 0.2
<i>Neutral lipids</i>		
Triacylglycerol (TAG)	922.2 \pm 379.4	873.8 \pm 242.2
Cholesterol	1414.4 \pm 476.6	1227.8 \pm 249.9
Free fatty acid	1406.0 \pm 425.6	1228.2 \pm 221.7
Steryl ester	–	–
Polar lipids	230.6 \pm 65.9	223.1 \pm 37.8
TAG/CHOL index	0.64 \pm 0.06	0.70 \pm 0.09

L'Estartit – Surface temperature anomalies



Salat & Pascual 2011. EFECTOS LOCALES DEL CAMBIO GLOBAL EN AGUAS COSTERAS (Local effects of global change in coastal waters). VII Congreso Ibérico de Gestión y Planificación del Agua. Toledo, Spain.



Possible future scenarios and final conclusions

Scenario 1

No changes in plankton community

anchovy

sardine

Scenario 2

Changes in plankton community ([Molinero et al. 2005. Limnol. & Oceanogr. 50\(4\)](#); [Conversi et al. 2010. PLoS ONE 5\(5\)](#))

anchovy

sardine

Scenario 3

Balance between changes in trophism and in reproduction

anchovy

sardine

- We can not assure whether the lack of alternations between anchovy and sardine in the western Mediterranean is due to their lack of diet overlap or to their opposite spawning periods.
- Anchovy and sardine larvae in the Gulf of Lions could coincide in the future under the current temperature trends, and will likely compete for food, making both populations more vulnerable to any additional disruption, and especially to fishing.
- Since there are no alternations of anchovy and sardine in this non-upwelling area, populations would not have any chance of recovering during regime shifts.
- We cannot be sure of the future response of anchovy and sardine to the climatic changes, thus, in the short-time period, only by properly managing their fisheries we can guarantee the survival of these populations.



**Thank you for
your attention**