

chia-ting.chen@mio.osupytheas.fr



Institut Pythéas
Observatoire des Sciences de l'Université
Aix-Marseille Université



Do diet variations influence body condition of the French Mediterranean planktivorous teleosts?

Chia-Ting Chen¹, Daniela Bănar¹, David Costalago², Baptiste Le Bourg³, Anaïs Esposito¹, Manon Gautier¹, Christian Ré¹, Loïc Guilloux¹, Mireille-Harmelin Vivien¹, Claire Saraux⁴, Benoît Mialet^{5,6}, Jean-Hervé Bourdeix⁴, François Carlotti¹

¹MIO- Mediterranean Institute of Oceanography, France; ²Department of Ecology, Environment and Plant Sciences, Stockholm University, Sweden; ³MARE- Laboratory of Oceanology, Belgium; ⁴MARBEC- MARine Biodiversity, Exploitation and Conservation, France

⁵LOG- Laboratory of Oceanology and Geosciences, France; ⁶LIENSs- Littoral Environnement et Sociétés, France

Context

Over the last decade, biomass and landings of the European pilchard (*Sardina pilchardus*) and European anchovy (*Engraulis encrasicolus*) have declined, with smaller and leaner individuals [1, 2], inducing a fishery crisis in the French Mediterranean Sea. This raises the question of whether diet may have affected the relative body condition of the fish.

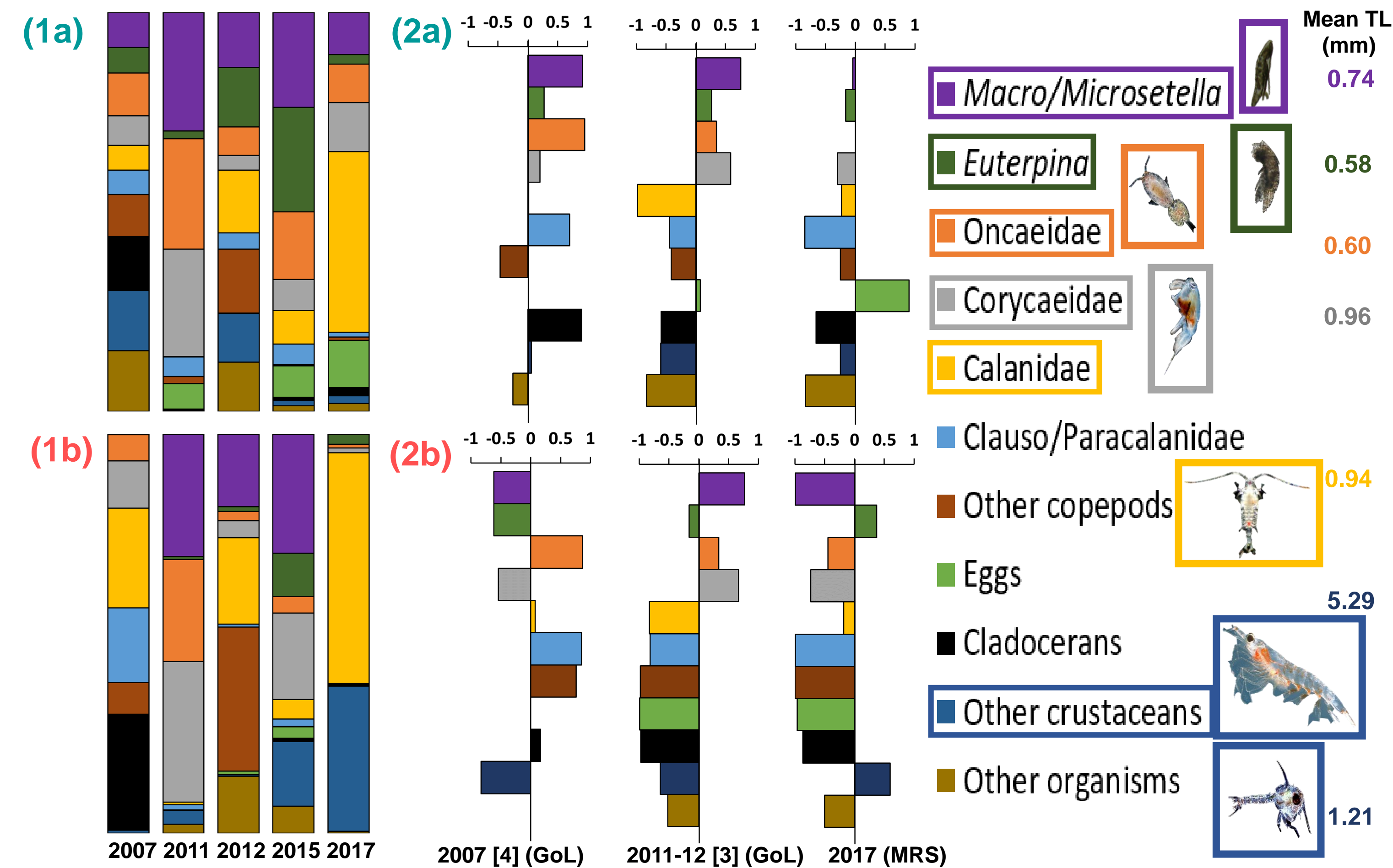


Fig. 1. Proportion of IRI% (Index of Relative Importance) of consumed prey of (a) sardine and of (b) anchovy during summer of 2007 to 2017. IRI% differed between years ($X^2=328.09$ for sardine, $X^2=677.74$ for anchovy, $p<0.01$ for both).

Fig. 2. Ivlev's electivity index** of consumed prey of (a) sardine and of (b) anchovy during summer of 2007 to 2017. ** (comparing stomach content of fish with the samples of 200 and 80 μ m nets). Preference for prey type when the index is >0 . The legend is the same for Fig. 1, 2 & 5 with prey types with different color codes and mean total length (TL) of consumed prey types. GoL= Gulf of Lions; MRS= Marseille Bay.

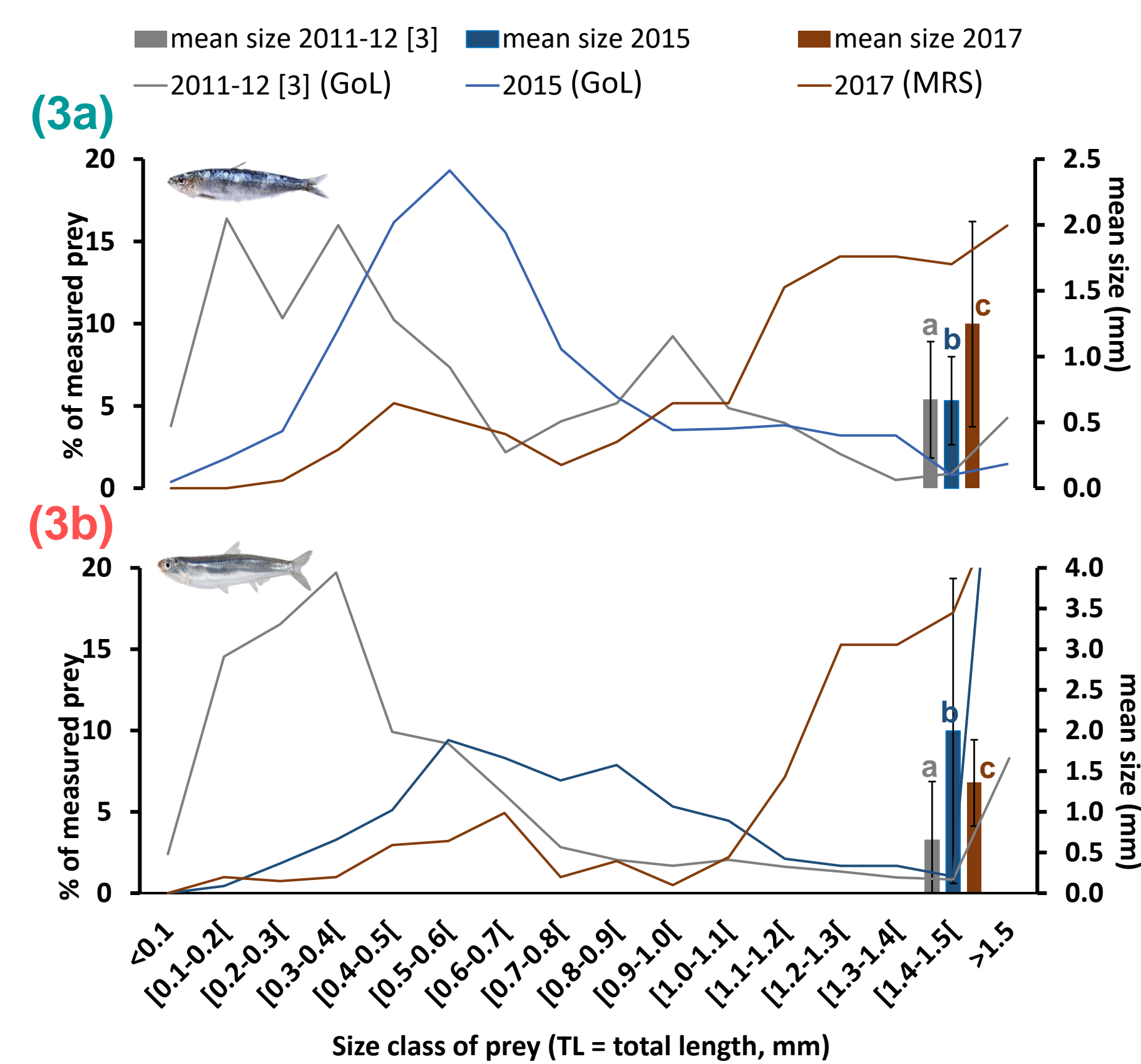


Fig. 3. Distribution of size classes and the mean size of consumed prey of (a) sardine and of (b) anchovy during summer from 2011 to 2017. For both species, mean size of consumed prey differed between years. Kruskal-Wallis $X^2=172.53$ for sardine and 201.76 for anchovy. Significance for both was $p<0.01$.

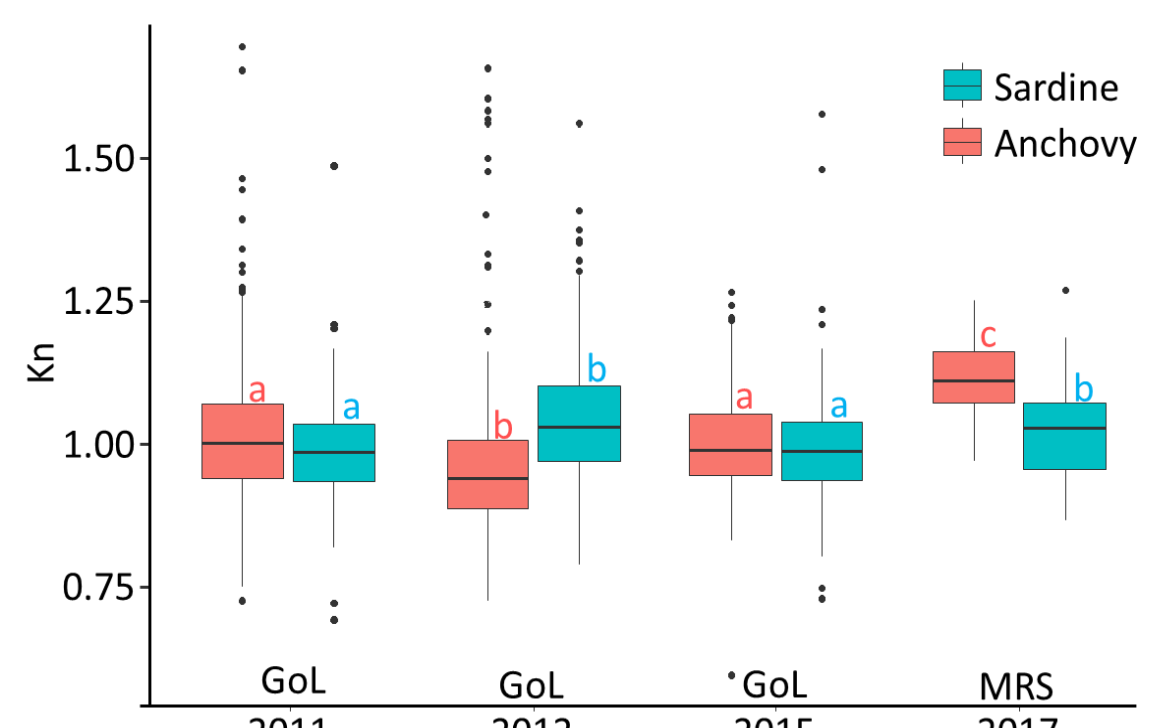


Fig. 4. Boxplots of Le Cren's relative body condition (Kn) for sardine and anchovy during summer from 2011 to 2017. For both species, Kn differed between years. Kruskal-Wallis $X^2=39.08$, $p<0.001$ for sardine. For anchovy, Kruskal-Wallis $X^2=66.90$, $p<0.01$.

Results & Discussion

- ✓ High temporal variation of diet (Fig. 1) and active selection of some prey species (Fig. 2).
- ✓ The size distribution and the length of prey changed with larger prey in recent years (Fig. 3).
- ✓ The relative body condition fluctuated with better body condition in 2017 (Fig. 4).
- ✓ Diet, total body length and total mass differed spatially for anchovy. Shelf edge populations consumed large euphausiids and had better body condition (Fig. 5b).
- ✓ Correlation between the TL of prey and TL and W of fish. Similar results in 2011-12 [3] where both species at the shelf edge eat euphausiids and large calanids and had higher TL and W.
- ✓ Relative body condition linked to the energy content of the alimentary bolus (Fig. 6). In winter, the sardine fed on smaller and less energy rich copepods (ex: Microsetella) and had poor body condition [5]. The increasing consumption of eggs and larger Calanidae copepods, with higher energy content improved relative body condition between February and July 2017 (Fig. 6).

Conclusion & Perspectives

Relative body condition and morphometry of small pelagic fish may be related to diet since higher values were reported during periods and in areas where they consumed larger prey. Relative body condition of fish was also related to prey energy content. We hypothesize that over the last decade, there was probably a decline in energy content in the plankton community (species composition and/or size). Analysis of the variations in plankton energetics longer term should be performed and related with environmental parameters for a better understanding of the mechanisms and causes.

Acknowledgements

Many thanks to: Doctoral School 251 (grant MENRT), the managers of the programs SOMLIT and ROMARIN, the MIM (Microscopy and IMagery) platform of the M.I.O., the crew of ANTEDON II, and the fishermen who collected the fish samples, C. Losson and T. Robert for their help during the dissections, M. Fauchaux, B. Carré and E. Mery for their help during biochemical analyses and J. Blanchot for advice for the realization of the poster.

Objectives

The aim of our research was to explore the inter-annual and spatial variability of the European pilchard (sardine) and the European anchovy's relative body condition in relation to their diet in terms of species composition, size and the energy content of the alimentary bolus.

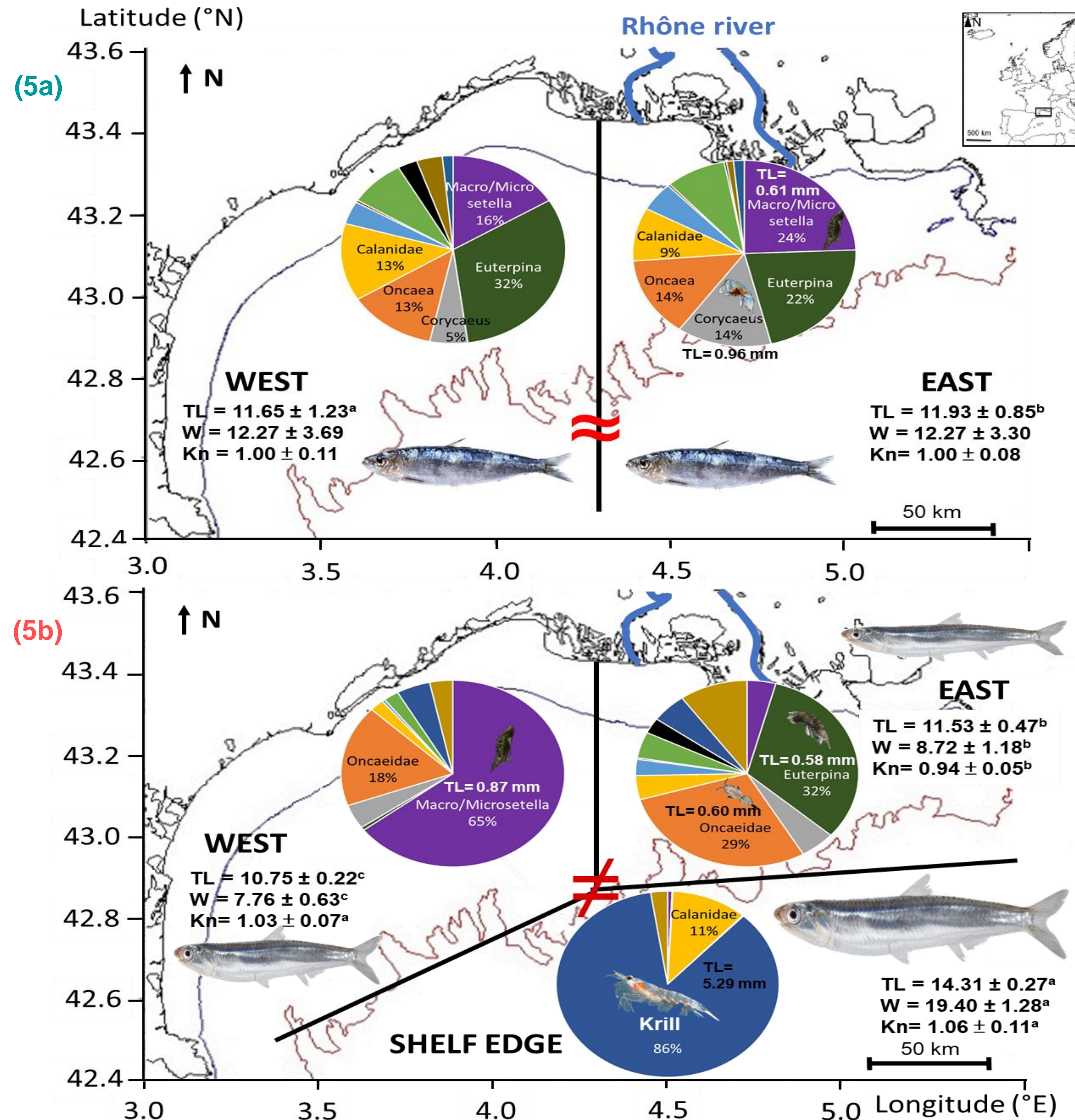


Fig. 5. Spatial analyses of the diet of (a) sardine and of (b) anchovy in July 2015 in the Gulf of Lions in relation to their morphometry. See legend of Fig. 1&2 for color codes of prey types. For anchovy, the diet ($X^2=370.57$), total body length (TL) (Kruskal-Wallis $X^2=139.15$), total body weight (W) (Kruskal-Wallis $X^2=100.58$) and body condition (Kn) (Kruskal-Wallis $X^2=97.60$) differed between the three regions. For sardine, only TL differed between regions (Kruskal-Wallis $X^2=7.33$). Significance was recorded as $p<0.01$ for all the above tests. High correlation was found between the mean size of consumed prey with both TL ($r=0.90$, $p<0.01$) and W ($r=0.92$, $p<0.01$) for anchovy while it was low for sardine ($r=0.29$, $p<0.05$ for TL and $r=0.31$, $p<0.01$ for W).

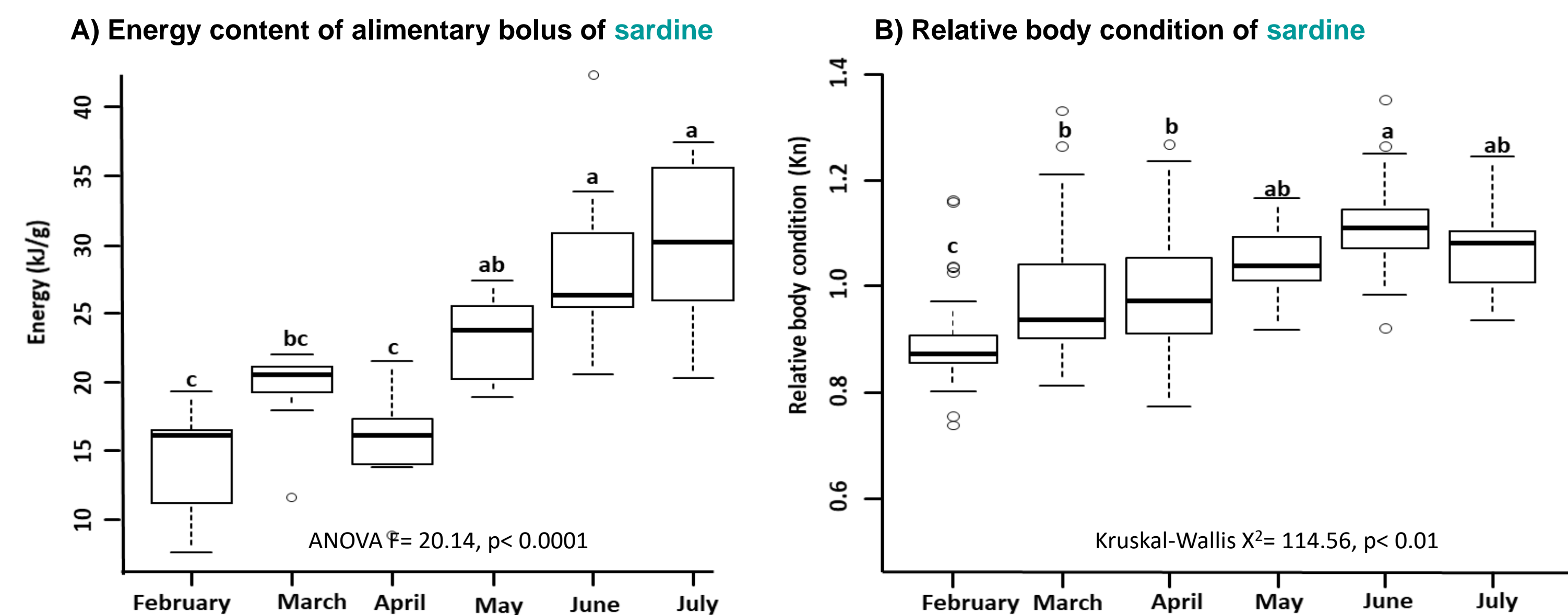


Fig. 6. In Marseille Bay, from February to July 2017, when (A) energy content (kJ/g of dry mass) of the alimentary bolus of sardine increased, its (B) relative body condition (Kn) (Le Cren) also increased ($r=0.32$, $p=0.02$).

Material & Methods

Sardine and anchovy were sampled from June to August in 2007 [4], 2011 & 2012 [3], 2015 (MSFD), in the Gulf of Lions (GoL) and in the bay of Marseille (MRS) in 2017. Fish stomach content was analyzed (with IRI%, Relative Importance Index and Ivlev's Electivity Index) and prey size was compared with plankton sampled with 200 and 80 μ m nets. In 2017, biochemical analyses were done to determine the energy content of the alimentary bolus of sardine. Fish condition (Le Cren's Kn) and morphometry (total body length TL and weight W) were linked to prey size and groups.

References

- [1] Brosset, P. 2016. PhD thesis; [2] Van Beveren, E., et al. 2014. Mar. Biol. 161, 1809–1822; [3] Le Bourg, B., et al. 2015. J. Sea Res. 103, 138–146; [4] Costalago, D., et al. 2014. J. Sea. Res. 89, 64–72; [5] Chenm C.-T. et al. 2018, 53th EMBS, Ostend, Belgium.

FISHFORUM2018 FORUM ON FISHERIES AND THE SCIENCE

10-14 DECEMBER 2018
FAO HEADQUARTERS, ROME - ITALY