Discussion

The long-term decline in $\delta^{15}N$ values in the species analysed, disregarding their trophic level, suggests a generalized drop in the whole food web. Strong relationships between $\delta^{15}N$ signature declines with increasing bottom temperatures suggest a shift in diet to prey of lower trophic status in warm years.

The trend observed for practically all organisms (with the exception of formalin-fixed large benthopelagic fishes) is toward greater depletion of $^{13}C$ in current period samples, in agreement with a greater consumption of zooplankton due to both changes in NAO and the associated increase in zooplankton biomass from 1988 (Piontkovski et al. 2006; Conversi et al. 2010), and to the increase of bottom temperature in turn resulting in lower benthic prey biomass (Cartes et al. 2015).

We hypothesize that the changes in oxygenic conditions, driven in the Mediterranean by both global change and river damming, have influenced benthic organisms by reducing their biomass and/or size, shifting megaфаunal predators to more pelagic or smaller benthic prey (i.e., those with lower $\delta^{15}N$ values).

Materials & methods

Study area

Samples were collected within the framework of the Spanish funded projects BATIMAR, the BIOMARE and ANTRONARE (Figure 1). BATIMAR cruises were carried out in 1985-1989, so we called this the ‘80s period. By contrast, BIOMARE and ANTRONARE cruises were performed in 2007-2011, so we named them “the current period”. Samples were all collected with the same sampler, an OTSB-14 bottom trawl net. In both periods we analysed samples taken between ca. 1000 and 2250 m, at depths free of any fishing activity and at the same stations.

Stable isotope analysis (SIA)

Species selected for this comparison were those dominant in the megaфаunal assemblage in terms of both abundance and biomass (Papiol et al. 2012). For SIA we followed standard protocols already used for deep-sea macro- and megaфаuna (see details in Fanelli et al. 2013).

Environmental data collection

Temperature (T), salinity (S) and dissolved oxygen ($O_2$) near the bottom (in the Benthic Boundary Layer, O$_2$ BBL) and at the LIW core ($O_2$ LIW), were obtained in 2007-2011 from CTD casts, while data from 1985-92 were compiled by Cartes et al. (2015), from oceanographic cruises performed in the area in 1984-1993 and from the MEDATLAS database. Possible differences in the climatic regime between the two periods were considered based on winter and annual NAO (North Atlantic Oscillation) indices (http://www.cru.uea.ac.uk). Chlorophyll $a$ concentration (http://gdota1.sci.gsfc.nasa.gov), as a proxy of food input, and river discharge from the main adjacent rivers were also considered.

Environmental scenario: increase of temperature and salinity from the ‘80s until now, with a parallel decrease of $O_2$ (both at LIW and BBL) and Chlorophyll $a$ concentrations

Results

- The long-term decline in $\delta^{15}N$ in the species analysed, disregarding their trophic level, suggests a generalized drop in the whole food web. Strong relationships between $\delta^{15}N$ signature declines with increasing bottom temperatures suggest a shift in diet to prey of lower trophic status in warm years.
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References