SPATIAL DIFFERENCES OF STABLE ISOTOPE COMPOSITION AT BIVALVE *PINNA NOBILIS*: ARE THEY RELATED TO NUTRIENTS CONCENTRATIONS OR TO POTENTIAL FOOD SOURCE?

K. Magraner [1]*, S. Deudero [1], M. Vázquez-Luis [1], C. Alomar [1] and J. Alonso-Santos [1]
[1] Centre Oceanogràfic de les Balears - kikamagraner@gmail.com

Abstract
Increased anthropogenic nutrient loading (i.e., eutrophication) due to increasing human population in coastal areas will enhance the degradation of coastal marine ecosystem. The results of our analysis in the mantle of *P. nobilis* suggest an enrichment of $\delta^{15}N$ isotopic values in sites with high concentration of population density. $\delta^{15}N$ signature have been proposed as better tracers of eutrophication than $\delta^{13}C$. The fan mussel *P. nobilis* is a good bioindicator of changes of the Mediterranean littoral environmental quality as proposed by other authors. Spatial differences of stable isotope composition at *P. nobilis* are connected to potential food sources quality/quantity related to nutrients enrichment.

Keywords: Stable isotopes, Nutrients, Balearic Islands, Eutrophication, Bivalves

Introduction Carbon isotopic compositions of animals reflect their diet within about 1 ‰[1] and can be used to identify potential food sources for *P. nobilis* [2]. Several studies have focused on changes in $\delta^{15}N$ as an effect of changes in nutrient loadings from sewage treatment plants [3]. Initial impacts are likely to be missed if measurements are restricted to physicochemical water properties [4]; even though this problem can be solved if indicator organisms are used [4]. The aim of this study was to use *Pinna nobilis* as indicator of anthropogenic effects using stable isotopes analysis ($\delta^{13}C$ and $\delta^{15}N$) in mantle tissue. We hypothesized that: (i) there are spatial differences among localities at different scales (ii) *Pinna nobilis* stable isotopes concentrations are reflecting nutrient concentrations at the studied sites or if they are more influenced by potential food sources.

Material and methods Samples of *P. nobilis* were collected at Balearic Islands (Spain). A total of six sampling stations were selected under an eutrophication gradient and with regard to protection level. A total of 57 *P. nobilis* mantles were sampled. Potential common food sources for *P. nobilis* were collected: phytoplankton, zooplankton, living leaves of *P. oceanica* (P. leaves), epiphytes of *P. oceanica* leaves (P. epiphytes), decaying leaves of *P. oceanica* (P. detritus), the rhizomes of leaving *P. oceanica* (P. rhizomes), and particulate organic matter (POM). Nutrients were determined such as environmental variables. Stable isotope mixing models are used to determine the percentage contribution of the food sources to the fan mussel *P. nobilis*. In this study, we applied the SISUS Bayesian Mixing model.

Results and discussion The results for *P. nobilis* did not show evidence of size-related isotopic variability. The results obtained demonstrated that *P. oceanica* epiphytes made the highest contribution to the $\delta^{15}N$ signature of *P. nobilis* in Andratx, since this sampling site had the highest contribution of sewage compared to the other sampling sites (Figure 1). SISUS results showed that zooplankton made the highest contribution to the $\delta^{13}C$ signature in Illetes, Cargoler and Andratx (Figure 1); these results agree with those found by Davenport et al. [5] which demonstrated that the bivalve *P. nobilis* feeds on zooplankton. *Pinna nobilis* exhibits spatial differences at microscale and mesoscale level in N stable isotope composition as reflected by our results. In this study the mantle of *P. nobilis* was analyzed, providing values of $\delta^{15}N$ of 1.71‰ in Santa Maria Bay and 3.25‰ for Andratx (Figure 2). These variations could be related to nutrients availability of the studied sites [1]. Therefore, *P. nobilis* seems to provide indication of environmental quality linked with anthropogenic nutrient inputs.

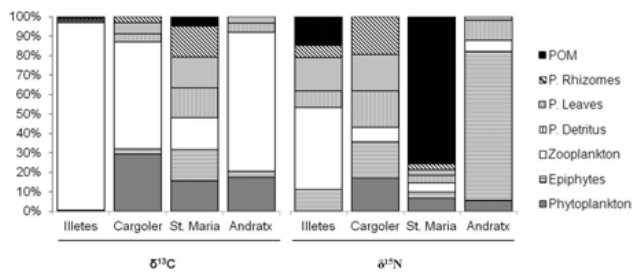

Fig. 1. Mean value from SISUS potential food sources contribution (%) of $\delta^{13}C$ (left) and $\delta^{15}N$ (right) to the diet of *Pinna nobilis* at different studied sites.

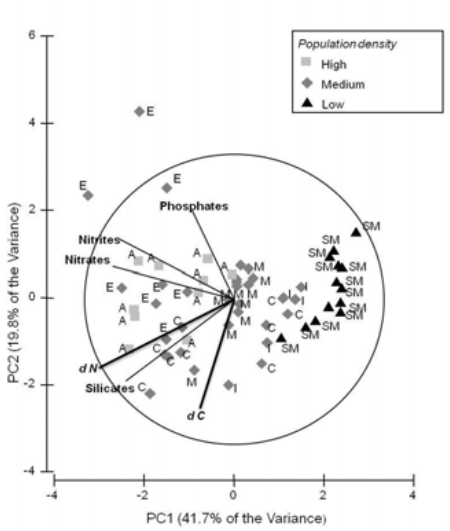

Fig. 2. Results of principal component analysis (PCA) of nutrients means and population density from the different studied sites (A-Andratx; C-Cargoler; E-Espalmador; I-Illetes; M-Migjorn; SM-Santa Maria). Values in brackets represent the percentage of variance explained by the PCA

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