ASSESING HEAVY METALS IN THE MARINE BIVALVE *PINNA NOBILIS* IN THE BALEARIC ISLANDS (WESTERN MEDITERRANEAN)

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Abstract
Heavy metals (Cd, Cu, Hg, Pb and Zn) concentration were determined in the marine bivalve *Pinna nobilis* along the Balearic Islands, comparing a protected area with two sites with strong anthropogenic influence. Analyses of Cabrera and Mallorca indicated that heavy metal concentration were generally higher in the most of samples, specially in Santa Maria bay (Cabrera, MPA), and Magaluf (Mallorca, with strong anthropogenic influence). *Pinna nobilis* appears to efficiently bioaccumulate heavy metals exhibiting large differences in a range of anthropic scenarios. The results on *P. nobilis* metal accumulation show that the concentrations decrease according to order: Zn > Cu >Pb> Cd > Hg.

Keywords: Balearic Islands, Bivalves, Metals, Bio-accumulation

Introduction
Heavy metals in marine biota have natural and anthropogenic origin, and are regarded as serious pollutants of the aquatic environment because of their toxicity, persistence, low biodegradability and their tendency to concentrate in aquatic organisms [1]. Many benthic organisms accumulate trace metals to the levels reflecting those in the environment, and the molluscs in particular may therefore be sensitive biomonitors of metal inputs. *Pinna nobilis*L., 1758 is a fan mussel endemic to the Mediterranean Sea and is consideredthe biggest bivalve mollusc of this area [2]. It is commonly found within the seagrass meadows, especially those of *Posidonia oceanica* [3], and the species is a long-lived filtering bivalve. There are numerous studies on heavy metals in the Mediterranean Sea, especially in sediment [4], seagrass meadows [1] and benthic invertebrate species [11], but there are few studies on large filter feeders like *P.nobilis*.

Materials and methods
The study area is the Balearic Islands coast, includes two islands, Mallorca (Andratx and Magaluf) and Cabrera (Santa Maria bay) included within a zone of integral protection. Fourteen *P. nobilis* samples were taken in October 2011 with scuba diving. Concentrations of Cd, Cu, Pb and Zn were determined by atomic absorption spectrometry (AAS), and Hg was determined by an Advanced Mercury Analyzer AMA 254. For comparison of total metals at the sampling sites, the metal pollution index (MPI) was applied ([8]; [9]; [1]): $MPI= (Cf_1 \times Cf_2 \ldots Cf_n)^{1/n}$; where the Cf_n is the metal concentration *n* in the sample.

Results and discussion
Metal concentrations in soft tissues of *P. nobilis* samples (dry weight) range from 1.21 to 33.1 mg/Kg for Cd, from 4.1 to 319.2 for Cu, from 0.247 to 1.158 mg/Kg for Hg, from 0.58 to 39 mg/Kg for Pb and from 1244 to 4529 mg/Kg for Zn (Table 1).

Tab. 1. Mean SD (min-max) mg/Kg dry weight and metal pollution index (MPI) by site. (n= number of samples)

sites	1.Andratx (n= 4)	2.Magaluf (n= 4)	3.Santa Maria bay (n= 6)
Metals			
Cd	1.613± 0.606 (1.21-2.5)	8.918 ± 3.002 (5.82-13.03)	26.435 ± 6.966 (15.03-33.1)
Cu	6.05 ± 2.204 (4.1-9.2)	197.85± 88.084 (127,1-319,2)	57.25 ± 30.405 (20.9-96.5)
Hg	0.297± 0.044 (0.25-0.35)	0.795 ± 0.22 (0.56-1.09)	0.957 ± 0.133 (0.82-1.16)
Pb	0.895 ± 0.21 (0.58-1)	20 ± 6.272 (12-27)	22.67 ± 5.164 (15-29)
Zn	4034.25± 358.71 (3670-4529)	1763± 607.879 (1244-2631)	2708.33±347.757 (2364-3224)
MPI	6.22 ± 0.528	34.446 ± 11.55	38.171 ± 8.2

All examined metals had maximal concentration in Santa Maria bay in Cabrera, excepte for Cu at Magaluf, and Zn in Andratx. The obtained concentrations are comparable with those reported for Pinnidae elsewhere ([4]; [5]; [6]; [7]). We compared the concentrations of all heavy metals by metal pollution index (MPI), and the MPI reaches the maximal value for site 3 (Santa Maria bay) linked to the highest concentrations of three metals (Cd, Pb and Zn).

Conclusions
Elevated metal concentrations can cause a severe reduction or elimination of intolerant species, thereby having a significant effect on the diversity and trophic structure of the biological community [10]. In view of the range of concentrations that can be found in the soft tissues of bivalves species, the magnitude of metals in the *P. nobilis* can be considered high. The species shows a high bio-accumulation capacity, thus further analysis are needed to assess their tolerance ranges to metal pollution and monitoring data indicate that the bioacumulation potential is sufficient to be of concern.

Acknowledgement
This work was supported by research Project (024/2010), "Organismo Autónomo de Parques Nacionales, Ministerio de Medio Ambiente y Medio Rural y Marino".

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