Lead in bones of pinnipeds shows Galapagos archipelago as a relatively pristine spot

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Introduction

✓**Lead** is a **toxic** trace element [1].

✓It is released to the marine environment mainly through **anthropogenic activities** (e.g., industry), but also by **wind-blown dust** from arid regions and other **natural sources**.

Objective: to investigate potential **geographic differences** of lead concentrations between Galapagos Islands, Mauritania and Uruguay (Fig. 1) using **pinnipeds** as **sentinels** of **lead pollution** in the marine environment.

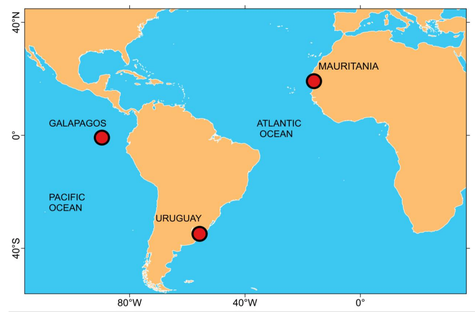

Fig. 1: Sampling sites.

Fig. 2: Skull of *Otaria flavescens*

Methods

- ✓ **Bone samples** were collected from **4 pinniped species** (Galapagos sea lion *Zalophus wollebaeki*, monk seal *Monachus monachus*, American fur seal *Arctocephalus australis* and South American sea lion *Otaria flavescens*; n=55 individuals; Fig. 1 & 2) that stranded dead or were incidentally bycaught by artisanal fisheries along the coasts of Galapagos Islands, Mauritania and Uruguay.
- ✓ As described in **Vighi et al. [2]**, 0.1 g of powdered bone sample was acid-digested in clean Teflon reactors using 2 mL of HNO3 (70%) and 1 mL of H2O2 (30%).
- ✓ After 12 h incubation at 90 °C, digested samples were diluted in 46 mL distilled water. Subsamples (10 mL) of diluted samples were analysed with an **ICP-MS or ICP-OES.**
- ✓ The **Bone Meal 1486 standard reference material** (NIST) and one **blank** were included in the analytical runs every 10 samples to validate analyses.

Results & Discussion

Table 1: Number of samples and lead concentrations (mean ± SD, median, max and min values, expressed in mg kg^{-1} dw) detected in the bone of pinniped species from Galapagos archipelago, Mauritania and Uruguay.

Species	Area	n	Tissue	Mean ± SD	Median	Min.	Max.
Zalophus wollebaeki	Galapagos archipelago	20	Bone	0.12 ± 0.07	0.10	0.05	0.37
Monachus monachus	Mauritania	11	Bone	1.80 ± 1.93	0.90	0.54	5.92
Arctocephalus australis	Uruguay	12	Bone	2.92 ± 4.35	1.70	0.27	16.27
Otaria flavescens	Uruguay	12	Bone	18.74 ± 49.95	1.14	0.44	175.14

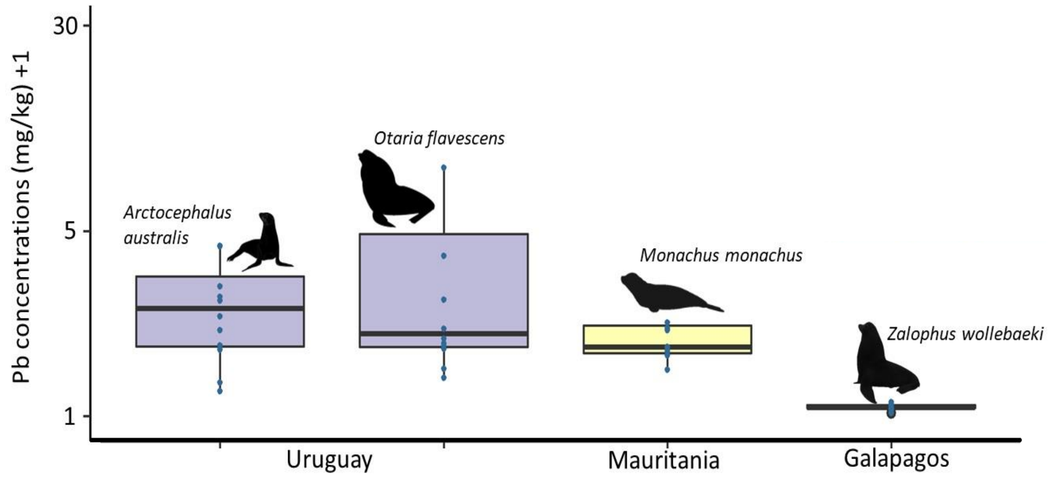

Fig. 3: Distribution of lead concentrations in the bone of the four pinniped species analysed. In purple the South American fur seal (Aa) and South American sea lion (Of) from Rio the la Plata estuary (Uruguay), in yellow the monk seal (Mm) from Mauritania and in black the Galapagos sea lion (Zw) from the Galapagos Islands (Ecuador).

- ✓ **Lead** was detected in all samples at concentrations ranging between **0.05 and 175.14** mg kg^{-1} dw (Table 1).
- ✓ The **lowest** lead concentrations occurred in pinnipeds from the **Galapagos Islands** (median = 0.10 mg kg^{-1} dw) (Fig. 3).
- ✓ Lead concentrations were **higher** in pinnipeds from **Mauritania** (median = 0.90 mg kg^{-1} dw) **and Uruguay** (median = 1.14-1.70 mg kg^{-1} dw) (Fig. 3).
- ✓ In **Mauritanian waters**, the likely origin of **lead** was wind-brought **Sahara dust**.
- ✓ In **Uruguayan waters**, the likely origin of **lead** was **industrial activity**.

Conclusions

✓The use of **pinniped** species as **sentinels of marine pollution** is a practical approach to assess relative differences between lead concentrations in separate marine areas.

✓The **Galapagos Islands** are a **pristine environment** for lead pollution as compared with the coasts of **Mauritania** and **Uruguay**, which are highly **impacted** by **natural and anthropogenic** sources of lead, respectively.

✓The present study supports the **validity** of **bone** to assess **lead concentrations** in marine organisms and, by extension, in their environment.

References

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