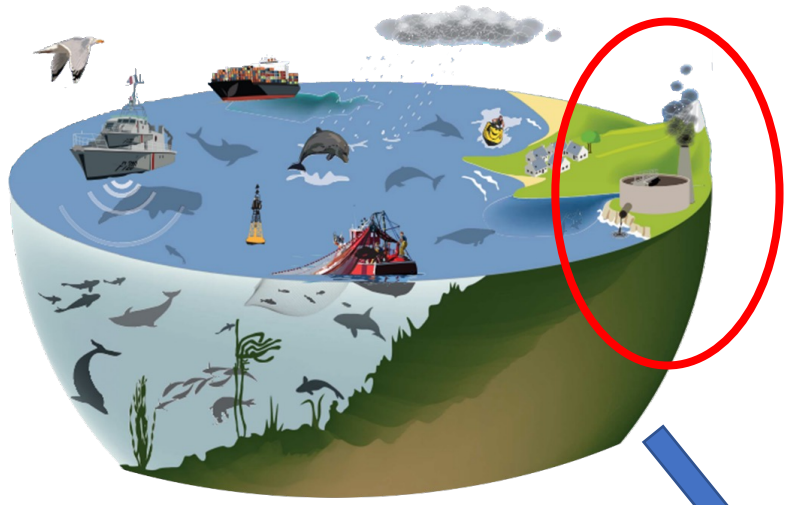
Temporal evolution of toxic trace elements in common dolphins from the bay of biscay and English channel

Méndez-Fernandez P, Spitz J, Dars C, Dabin W, Mahfouz C, André JM, Chouvelon T, Authier M, Caurant F

Context



Chemical contamination secondary pressure

1. Diversité biologique MNHN/AAMP
2. Espèces non indigènes MNHN
3. Espèces exploitées Ifremer
4. Réseau trophique marin CNRS INEE
5. Eutrophisation Ifremer
6. Intégrité des fonds marins BRGM
7. Conditions Hydrographiques SHOM
8. Contaminants Ifremer
9. Questions sanitaires ANSES
10. Déchets marins Ifremer
11. Énergie marine SHOM

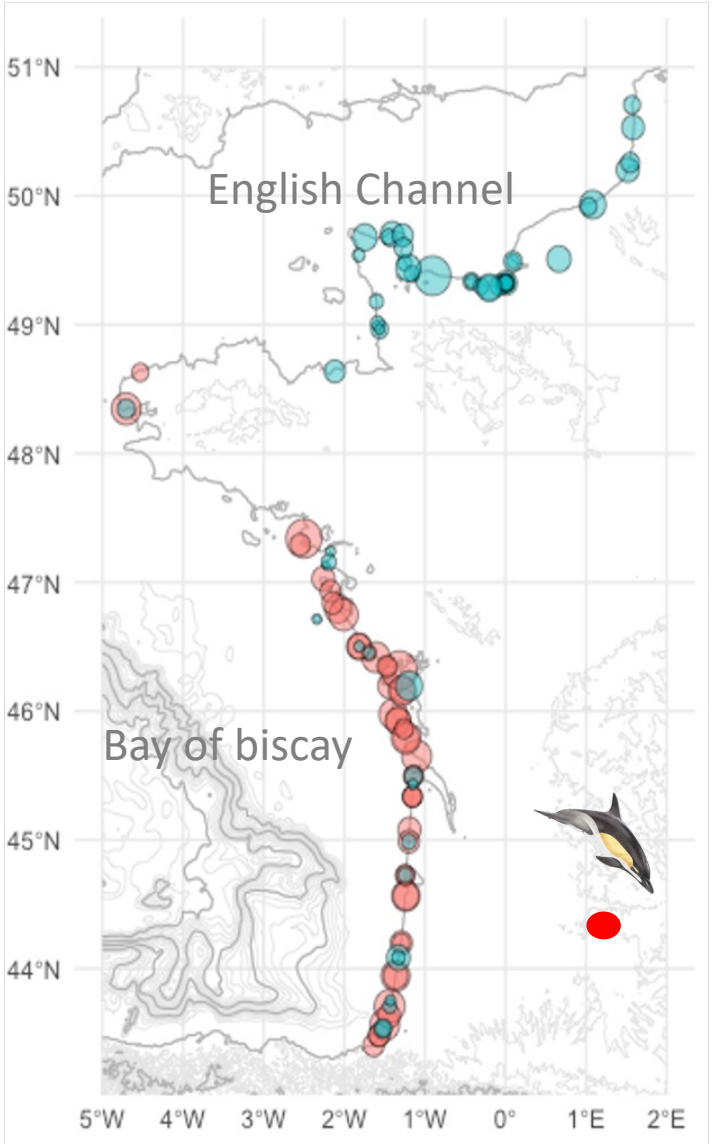
Pilotage : Direction de l'eau et de la biodiversité (DEB)
Coordination : DEB / Ifremer / AAMP

MSFD

Contamination monitoring since 2017

Réseau National Echouages

Sampling

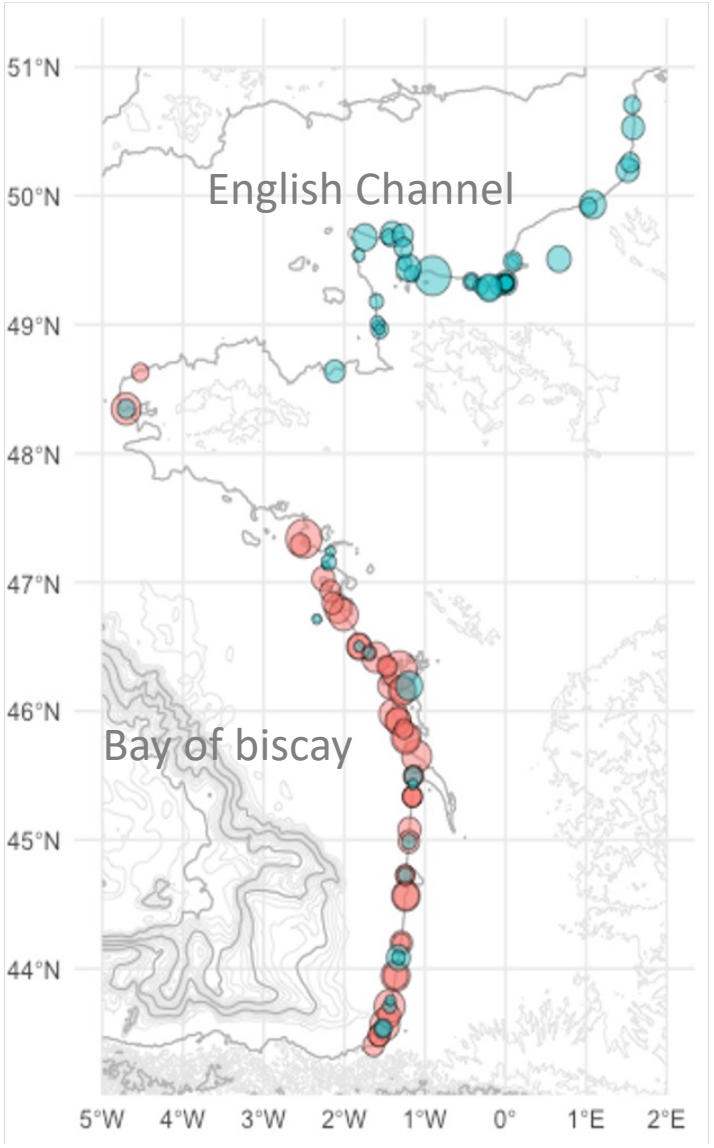


Hg & Cd	Pb
n = 201	n = 96
Liver and kidney	Liver
2001 - 2019	2006 - 2019

Bay of Biscay and English Channel

Mostly male adultes ♂

Data analysis



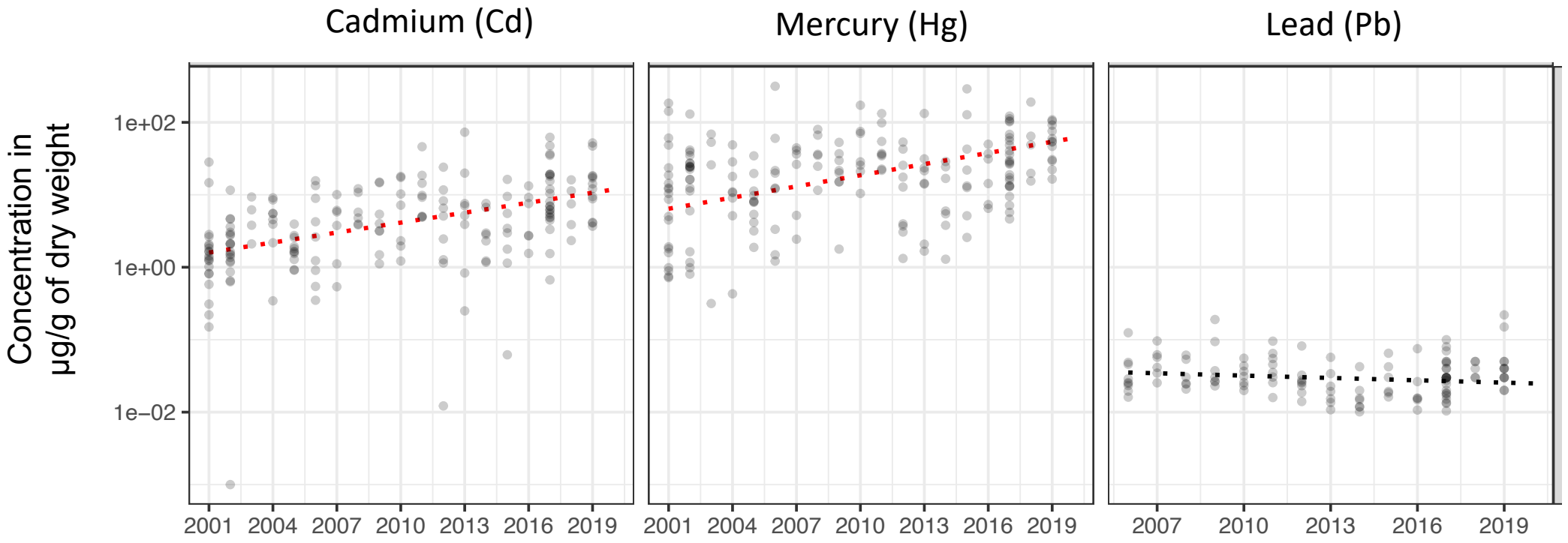
Dynamic linear model (DLM) & WAIC selection

Complet model:

Log [element] ~ Year + Age + Sex + $\delta^{13}C$ or $\delta^{15}N$

Data and code to reproduce the analyses are available at https://gitlab.univ-lr.fr/pelaverse/pelaMSFD

Results



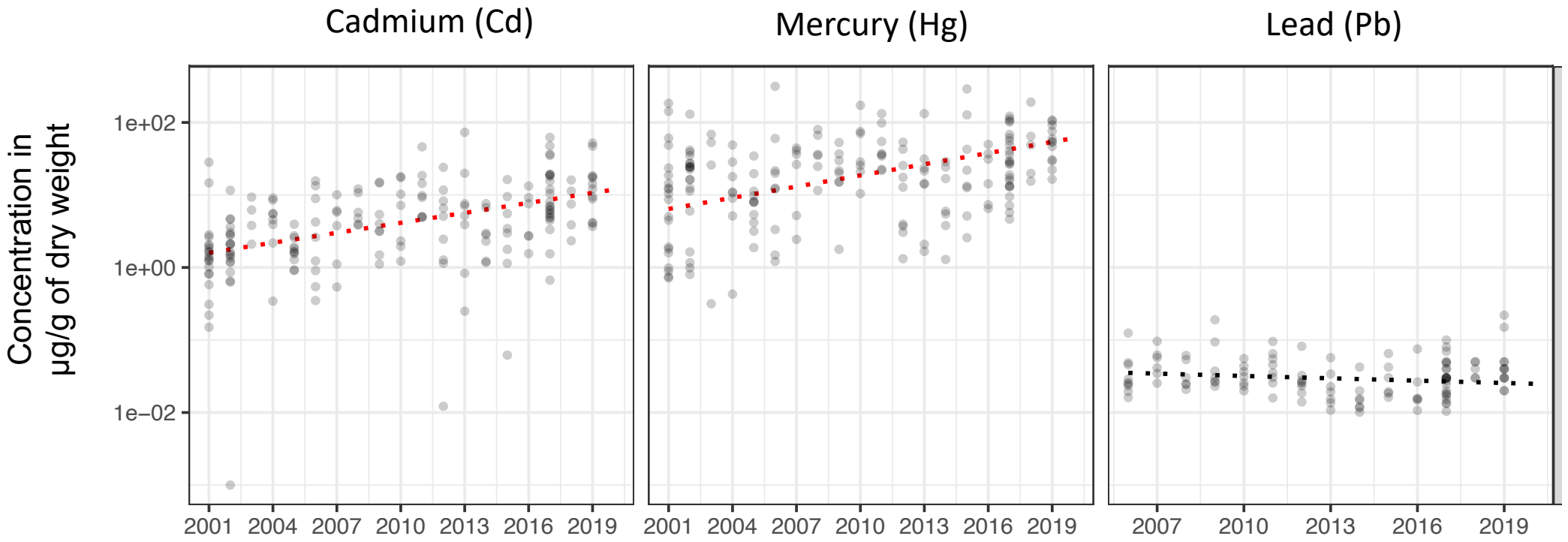
Raw data

mean = 7,40 + 8,87

mean = 37,4 + 40,6

mean = 0,070 + 0,040

Results

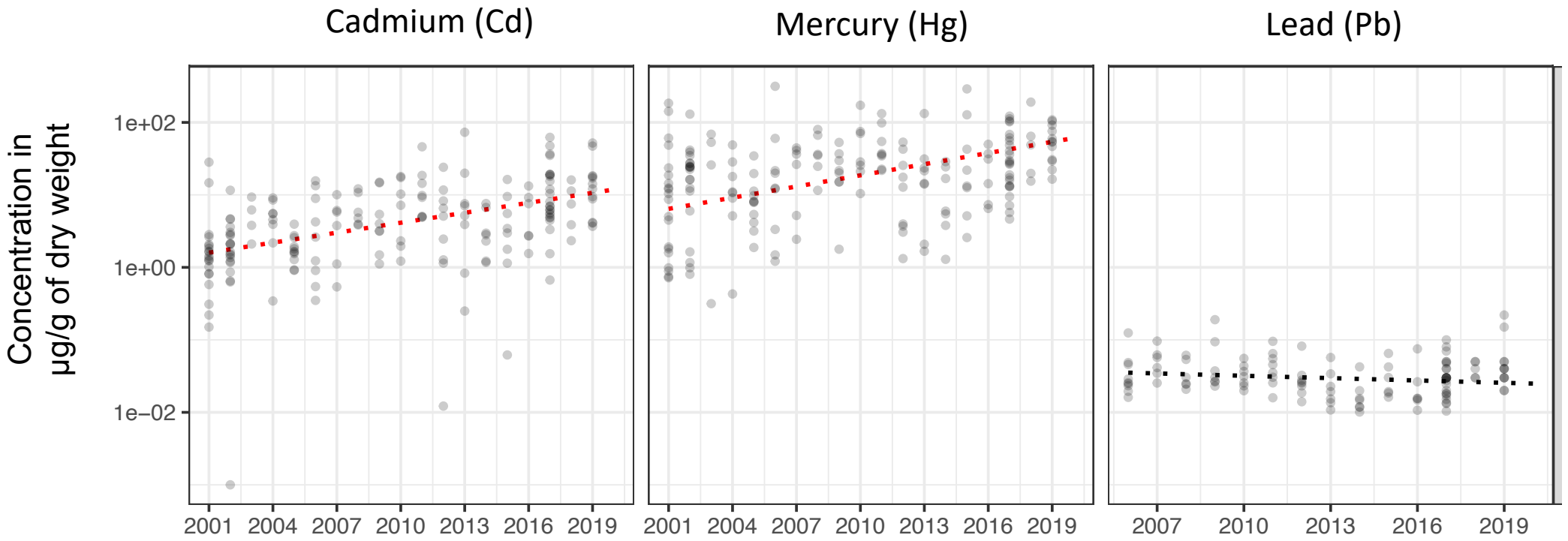


p-value < 0.005
0.427 µg/g/year

p-value < 0.005
1.96 µg/g/year

p-value > 0.005
- 0.001 µg/g/year

Results



Log[Hg] ~ year + sex + age + $\delta^{13}C$

Log[Cd] ~ year + sex + age + $\delta^{15}N$

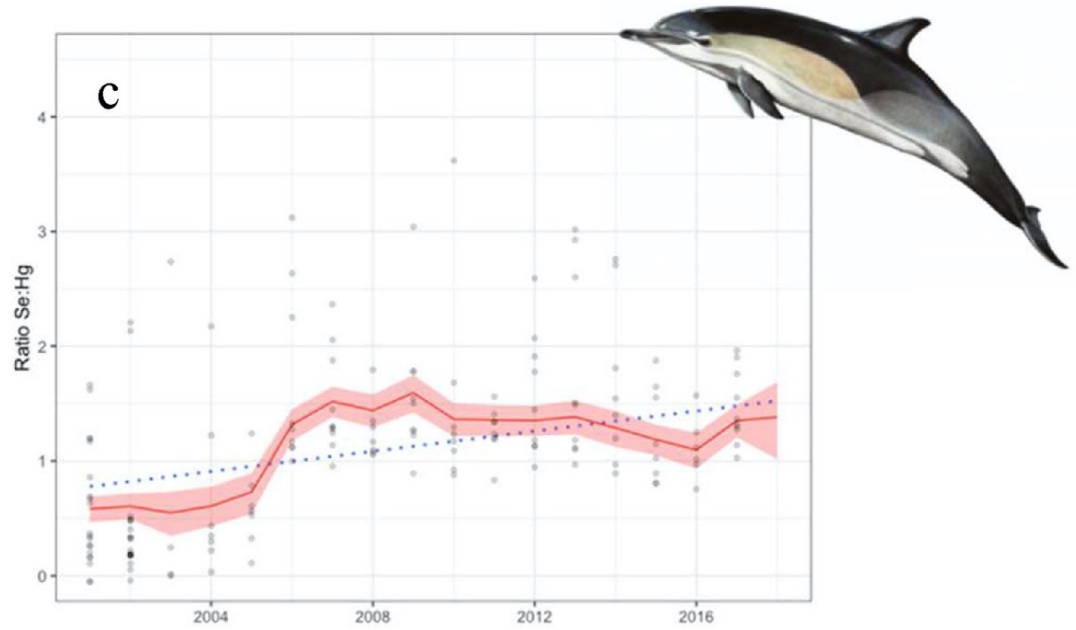
Log [Pb] ~ year + sex + age + $\delta^{15}N$

Discussion

- Decrease of Pb concentrations in accordance with bibliography and lead gasoline ban at the end of 1990s in the EU

- For Hg and Cd there is less clear trends worldwide and highly depending on species, latitudes and oceans

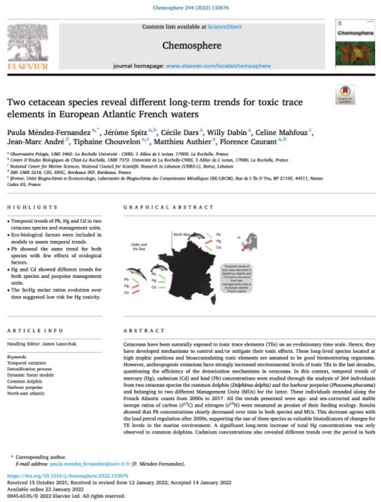
    - What about Hg detoxification through Se?



Conclusion

- We observed an increase for Hg and Cd concentrations in common dolphins in last 18 years, but also an effect of ecological factors reflecting the complexity to properly assess the contamination exposure of biota and the need to also monitor changes in prey or in foraging areas

- For Hg, despite that in theory there is a low risk for toxicity, we recommend to continue monitoring Hg in tandem with Se:Hg ratios in order to develop a more accurate indicator of what these concentrations mean in terms of compromising cetacean health.



Chemosphere 294 (2022) 133676

Contents lists available at ScienceDirect

Chemosphere

journal homepage: www.elsevier.com/locate/chemosphere

Two cetacean species reveal different long-term trends for toxic trace elements in European Atlantic French waters

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HIGHLIGHTS

- Temporal trends of Pb, Hg and Cd in two cetacean species and management units.
- Eco-biological factors were included in models to assess temporal trends.
- Pb showed the same trend for both species with few effects of ecological factors.
- Hg and Cd showed different trends for both species and porpoise management units.
- The Se:Hg molar ratios evolution over time suggested low risk for Hg toxicity.

GRAPHICAL ABSTRACT

ARTICLE INFO

Handling Editor: James Lazorchak

Keywords:
Temporal variation
Detoxification process
Dynamic linear models
Common dolphin
Harbour porpoise
North-east atlantic

ABSTRACT

Cetaceans have been naturally exposed to toxic trace elements (TEs) on an evolutionary time scale. Hence, they have developed mechanisms to control and/or mitigate their toxic effects. These long-lived species located at high trophic positions and bioaccumulating toxic elements are assumed to be good biomonitoring organisms. However, anthropogenic emissions have strongly increased environmental levels of toxic TEs in the last decades, questioning the efficiency of the detoxication mechanisms in cetaceans. In this context, temporal trends of mercury (Hg), cadmium (Cd) and lead (Pb) concentrations were studied through the analysis of 264 individuals from two cetacean species the common dolphin (*Delphinus delphis*) and the harbour porpoise (*Phocoena phocoena*) and belonging to two different Management Units (MUs) for the latter. These individuals stranded along the French Atlantic coasts from 2000s to 2017. All the trends presented were age- and sex-corrected and stable isotope ratios of carbon ($\delta^{13}C$) and nitrogen ($\delta^{15}N$) were measured as proxies of their feeding ecology. Results showed that Pb concentrations clearly decreased over time in both species and MUs. This decrease agrees with the lead petrol regulation after 2000s, supporting the use of these species as valuable bioindicators of changes for TE levels in the marine environment. A significant long-term increase of total Hg concentrations was only observed in common dolphins. Cadmium concentrations also revealed different trends over the period in both

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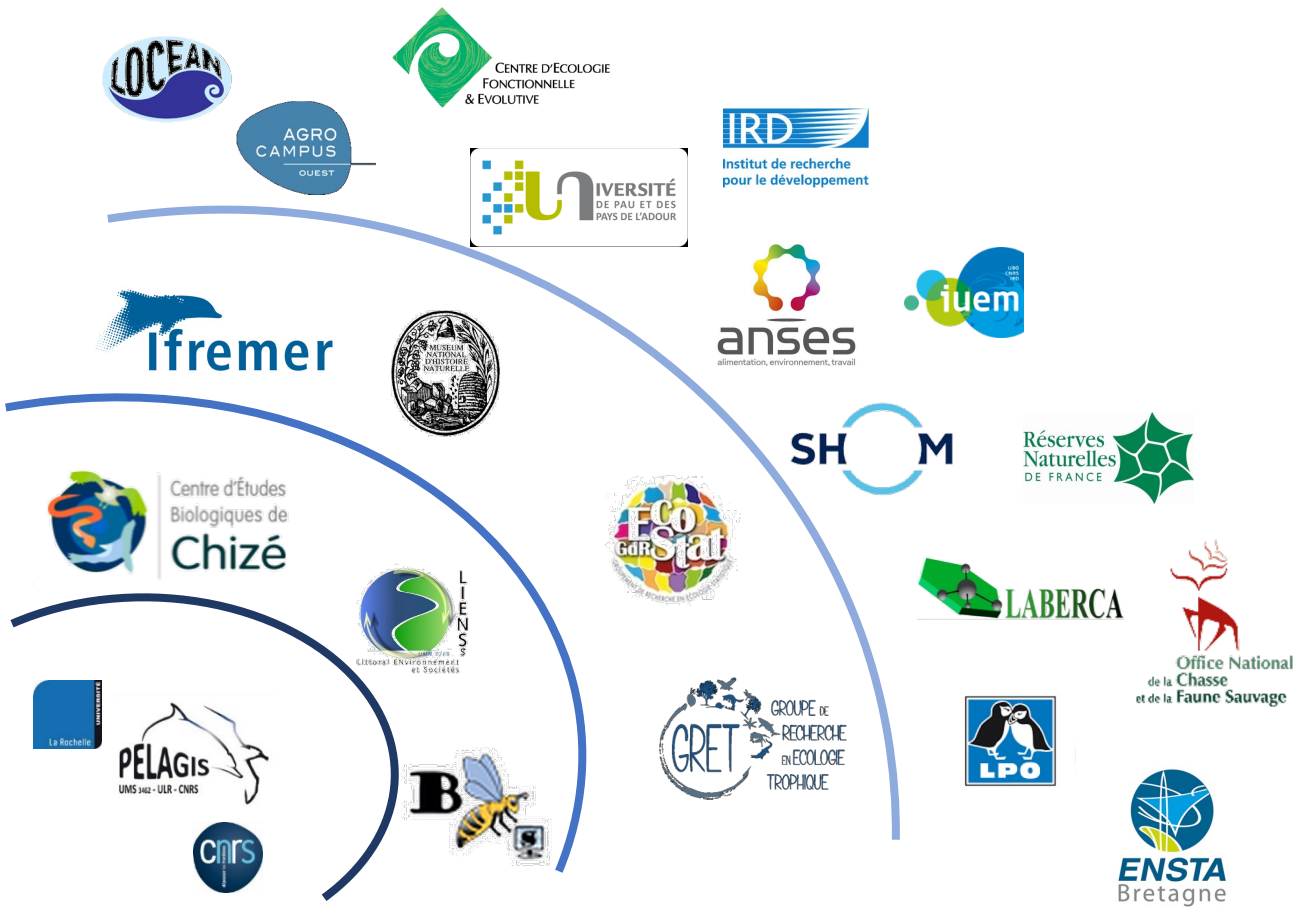
https://doi.org/10.1016/j.chemosphere.2022.133676
Received 15 October 2021; Received in revised form 12 January 2022; Accepted 14 January 2022
Available online 22 January 2022

Thank you!



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