UK Centre for Ecology & Hydrology

Biomonitoring of metals and second-generation anticoagulant rodenticides at the pan-European scale from 1996 to 2021 with wild Common Buzzards (*Buteo buteo*)

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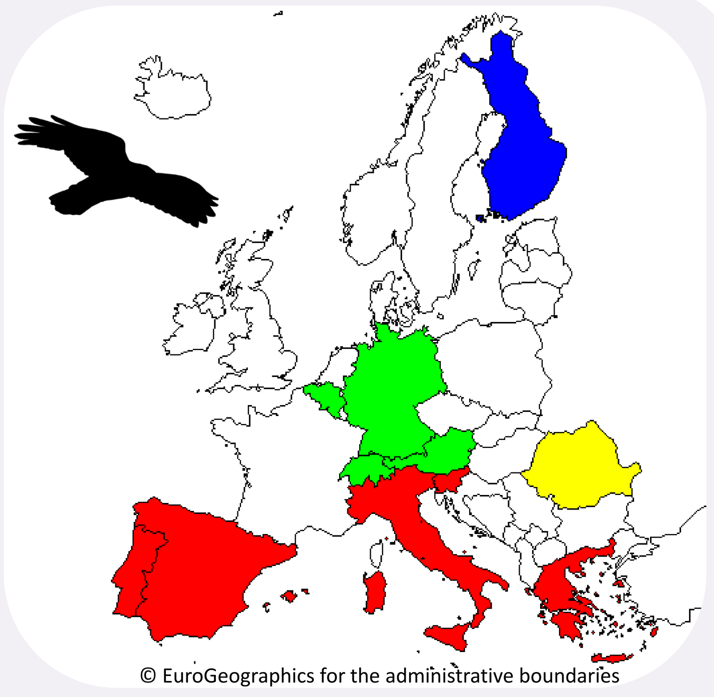
Background & Aim

Avian predators have been widely used for biomonitoring due to their high trophic position, long lifespan and large foraging areas. However, top-predator monitoring data are often temporally or regionally fragmented, which complicates long-term and large-scale chemical risk and hazard assessments.

We explored the utility of long-term contaminant monitoring at a pan-European scale. Using the common buzzard (*Buteo buteo*) as a sentinel species, we assessed the spatiotemporal trends of heavy metals and second-generation anticoagulant rodenticides (SGARs) at a European-wide scale.

Materials & Methods

- 129 **wild common buzzards** found dead or dying were collected from **11 European countries** from **1996 to 2021**.
- Livers from 2 or 3 individuals within a region of a country were pooled to increase the sample mass for multiple-contaminant analysis.
- Liver residues of **3 metals** (**Hg**, **Cd** and **Pb**) and **5 SGARs** (**bromadiolone**, **difenacoum**, **brodifacoum**, **flocoumafen** and **difethialone**) were measured in **64 pooled samples** by ICP-MS and UPLC-MSMS, respectively.
- Contaminant residues were compared among countries and European regions by the Kruskal-Wallis test.
- The temporal trend of contaminant residues was assessed by Generalised Additive Mixed Models (GAMM) with European regions as a random effect.



11 European countries
(blue: northern; green: western; yellow: eastern; red southern Europe based on the United Nations Geoscheme)

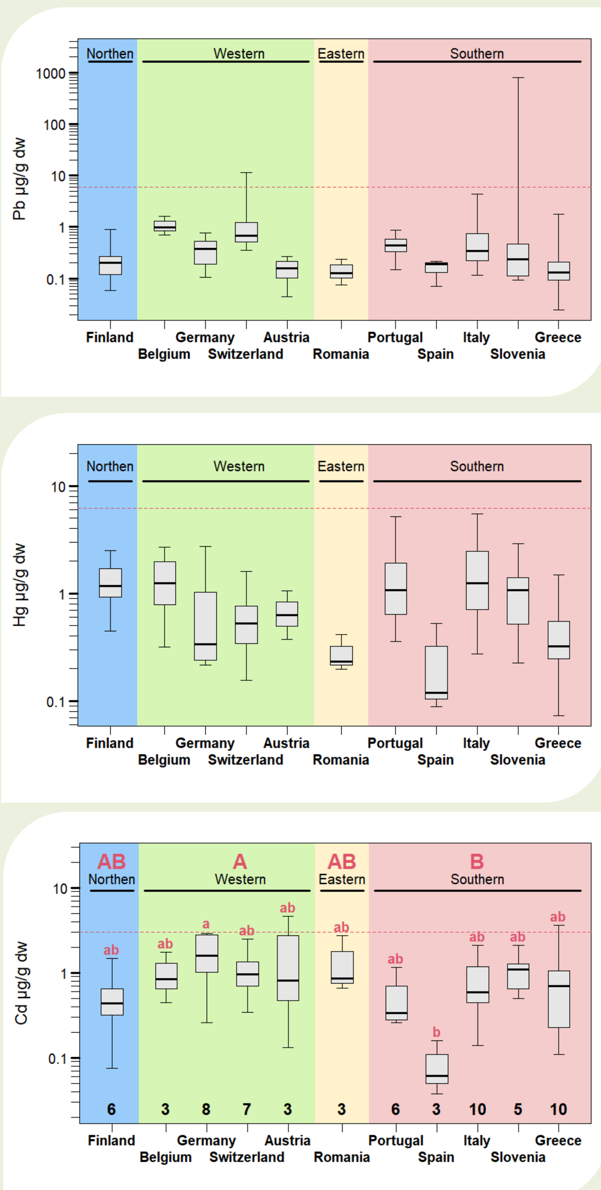
Results

Metals

Pb and Hg residues were not significantly different among countries and regions. **Cd residues were significantly higher in Western Europe than Southern Europe** and **in Germany than in Spain**.

No significant temporal trend was observed in liver metal residues.

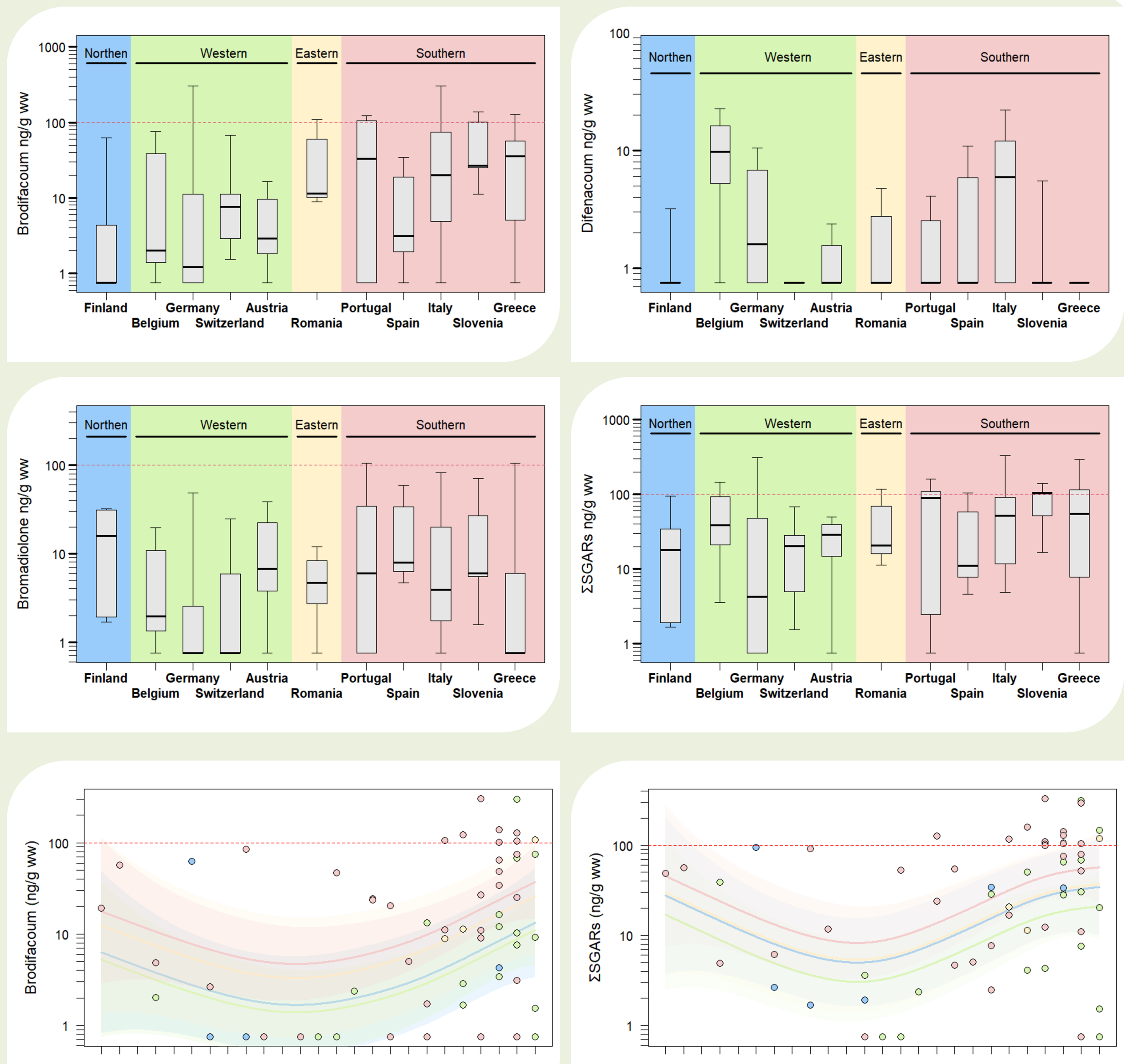
Thresholds –
Pb: 6 mg/g dw (Pain et al., 1995);
Cd: 3 mg/g dw (Scheuhammer, 1987);
Hg: 6.2 mg/g dw (Shore et al., 2011) with a conversion factor 3.1



SGARs

There was no significant difference in SGAR residues among countries and regions.

A significant temporal trend was observed in **brodifacoum**: **exposure decreased until the end of the 2000s and increased since then**. Summed SGARs (ΣSGARs) showed a similar temporal trend to brodifacoum.



Threshold – SGARs: 100 ng/g ww (Newton et al., 1990; 1999)

Discussion & Conclusion

64 pooled samples were analysed to investigate wide-spatial and long-span monitoring of selected contaminants. Despite such a small sample number, our data demonstrate a variation in exposure patterns among countries or European regions. Exposure to Cd significantly differed among countries. While exposure to SGARs significantly differ among regions or countries, exposure to brodifacoum has increased since the end of the 2000s. Given that no significant temporal trend was observed in the other SGARs, the increasing trend of ΣSGARs are explained by the increase in brodifacoum. The interpretation of these findings needs to consider the changes in chemical regulations over time, the potential disparity in the regulatory authorities, and differences in the ecology of the birds across Europe. Our study illustrates the importance of long-term and large-scale monitoring to clarify the factors generating variations among countries or regions.

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Acknowledgements: This research was carried out under the auspices of the LIFE APEX project funded by the European Union's LIFE programme (ENV/SK/000355).

Can large-scale and long-term monitoring of chemicals in raptors reveal spatial variance and temporal trends in exposure?

Yes, our study identifies such variance and trends across Europe.

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