Time trends (1996-2021) in PCB and PBDE congeners and in ΣPCBs and ΣPBDEs residue concentrations in the common buzzard *Buteo buteo* in 11 European countries in relation to restrictions on chemicals use

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Introduction

Top predators such as raptors are frequently used as sentinels for bioaccumulating chemicals, with potential for regulatory applications including assessment of efficacy of chemical risk management measures, chemicals risk assessment, and early warning of emerging contaminants. Such applications offer substantial promise in relation to the EU zero pollution ambition and the aim to protect both humans and wildlife from harmful effects of chemicals. However, little research has explored the potential for such applications at Europe-wide scale, in particular for the assessment of efficacy of risk management measures.

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Objectives

Our objective was to explore time trends in PCBs and PBDEs in the common buzzard *Buteo buteo* across Europe over the 25 year period 1996-2021, in relation to the timing of regulatory restrictions on the use of these chemicals. We used the common buzzard *Buteo buteo*, an apex species, which is widely distributed in Europe and has been identified as a suitable species for systematic monitoring of contaminant trends in terrestrial food webs at large spatial scales.

Materials and method

We analysed 64 buzzard livers from 11 European countries (Austria, Belgium, Finland, Germany, Greece, Italy, Portugal, Romania, Slovenia, Spain, Switzerland) from the period 1996-2021 for 31 PCBs and 23 PBDEs using GC-MS at the University of Florence. Samples were homogenized with sodium sulphate, spiked with a surrogate standard mixture and Soxhlet extracted using a solvent mixture 3:1 (v/v) n-hexane. Extracts were rotary evaporated, and 1mL was used for the gravimetric determination of the lipid content. Extracts were cleaned-up in multilayer silica gel column. Samples, reduced to a small volume, were spiked with an internal standard mixture and analysed by GC-MS operating in NCI mode for PCBs and PBDEs determination.

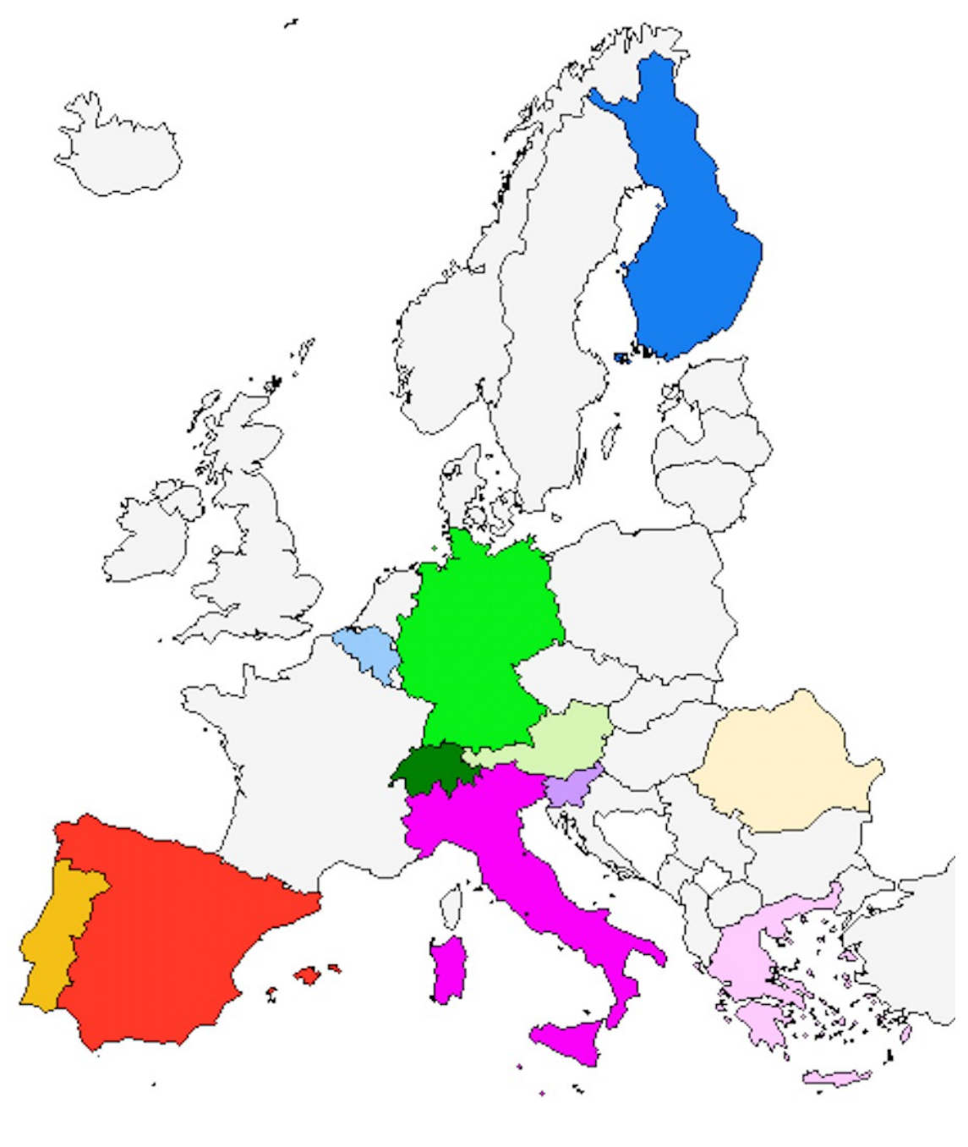

Figure 1. Map showing countries from which samples were obtained for this study.
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Results

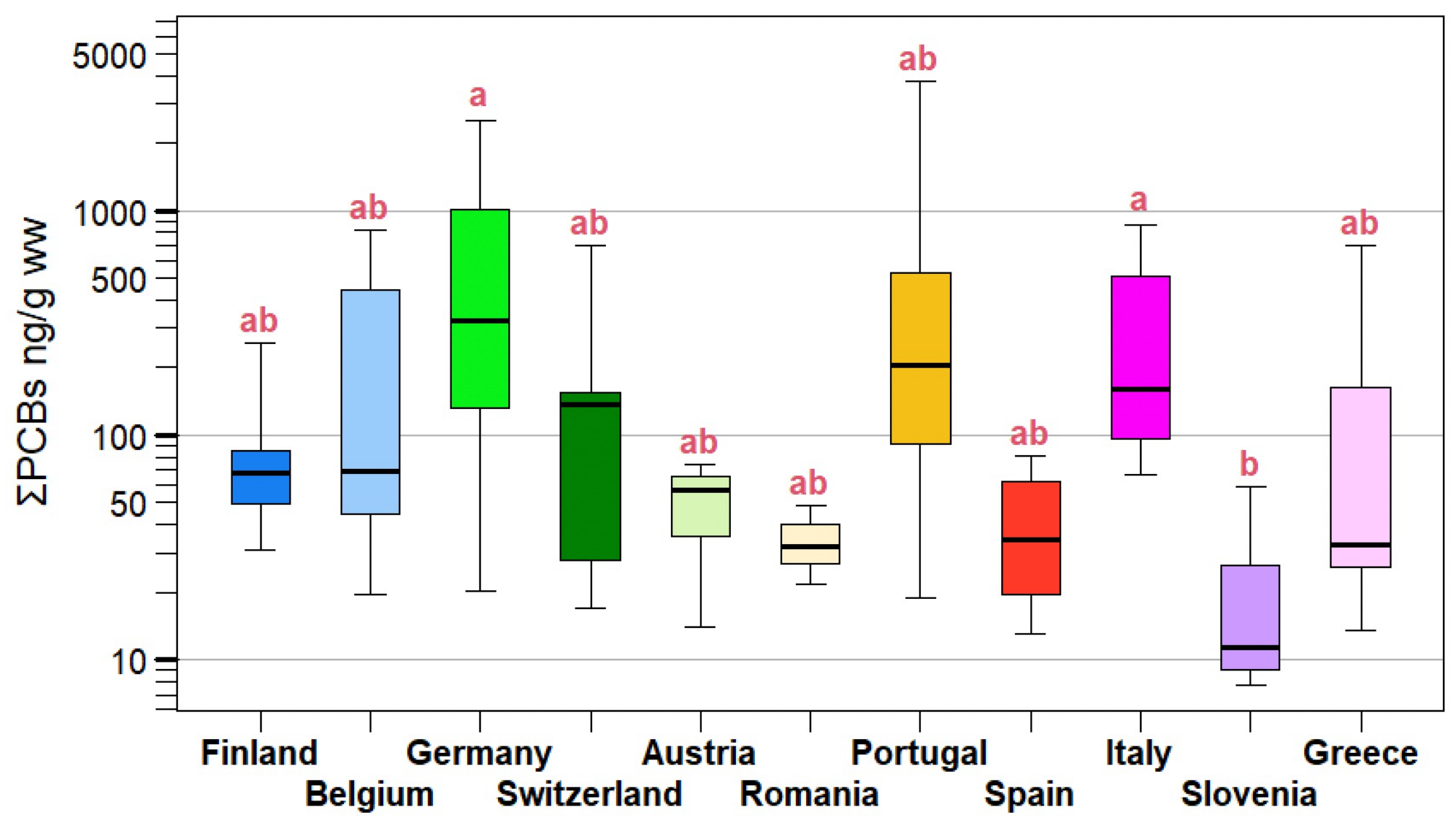

Figure 1: Difference in the summed PCBs among countries.

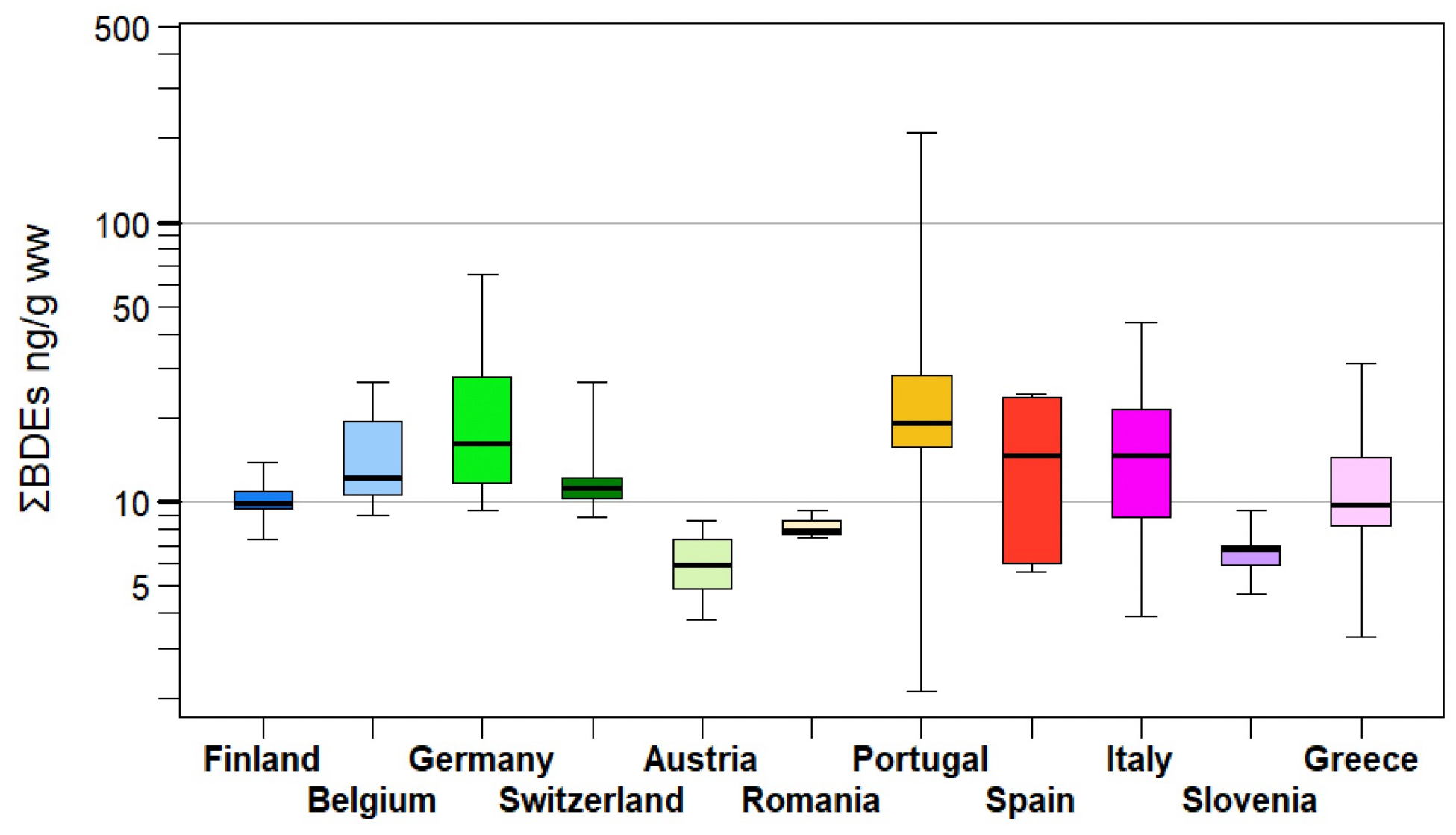

Figure 2: Difference in the summed PBDEs among countries.

Figures 1 & 2 show difference in the ΣPCBs (Fig 1) and ΣPBDEs (Fig. 2) among countries. ΣPCBs significantly vary among countries with the highest median ΣPCBs in Germany and lowest in Slovenia. Although the median ΣPBDEs is highest in Portugal and lowest in Austria, there is no significant difference in ΣPBDEs.

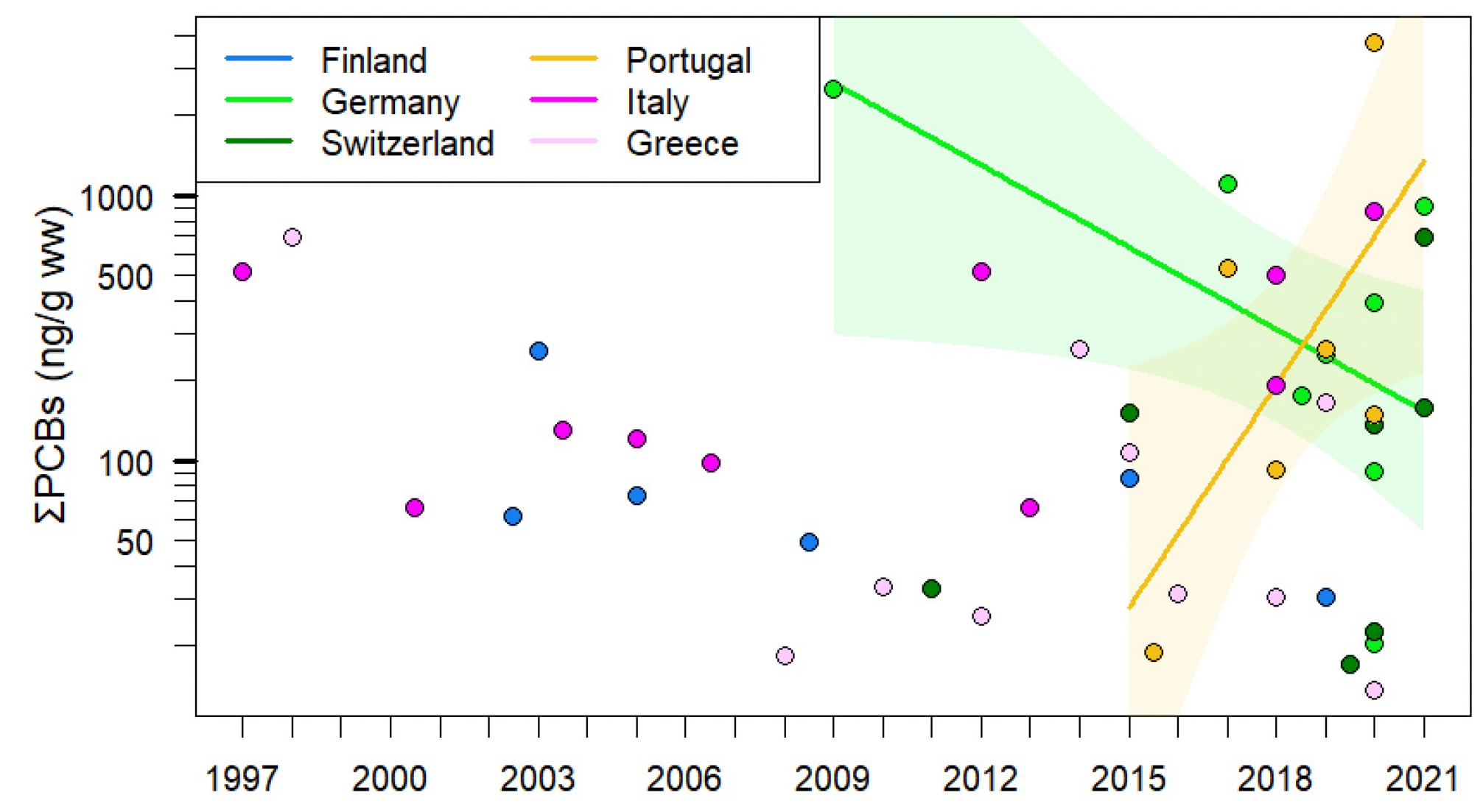

Figure 3. Significant time trends of dominant PCBs per country.

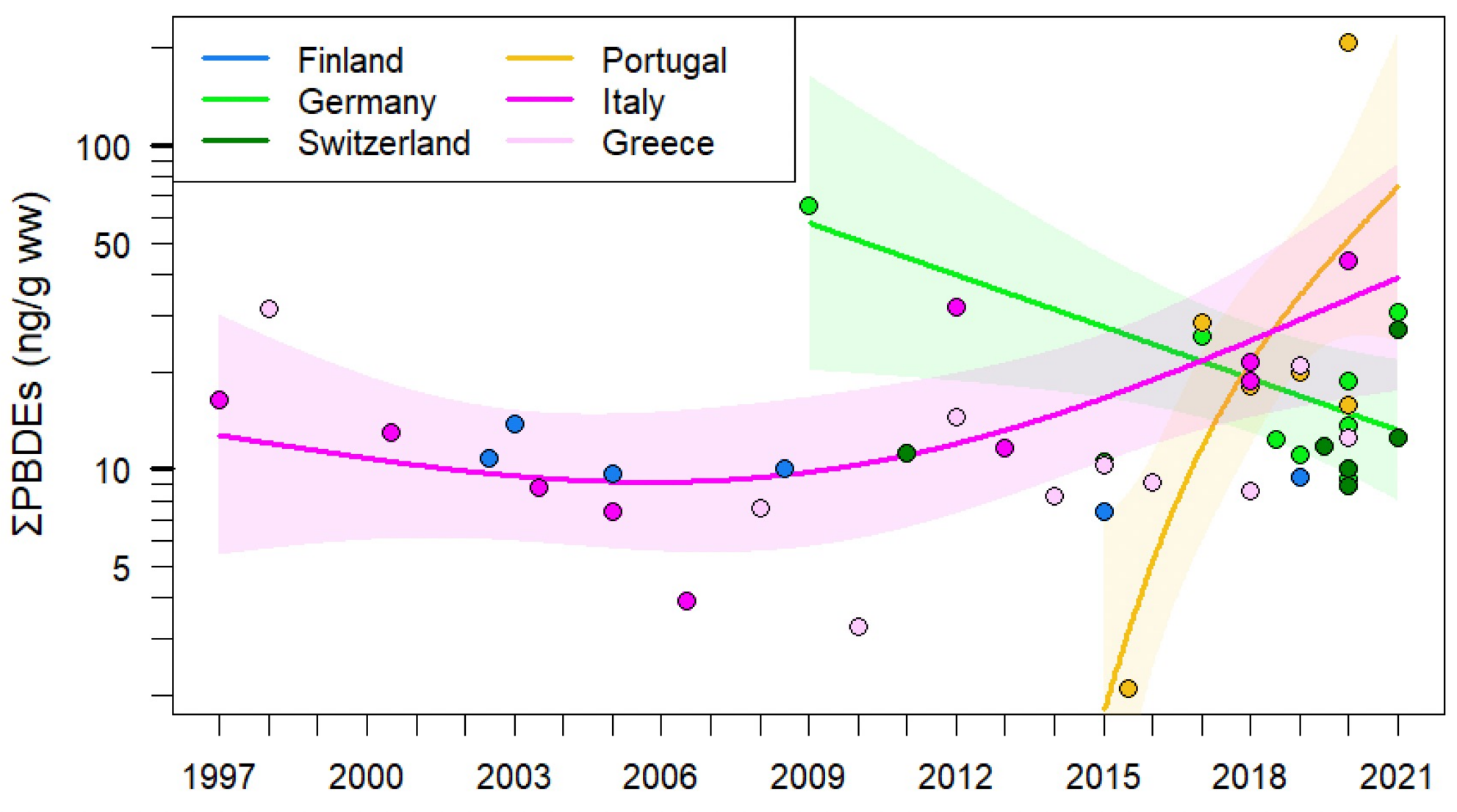

Figure 4 Significant time trends of dominant PBDEs per country.

Figures 3 & 4 show significant time trends in ΣPCBs (Fig. 3) and ΣPBDEs (Fig. 4). No significant trend is observed in ΣPCBs and ΣPBDEs in all samples together. Some significant trends are observed in some countries. However, the significant trends in Germany and Portugal may be due to outlier values. A clear trend is observed in ΣPBDEs in buzzards from Italy.

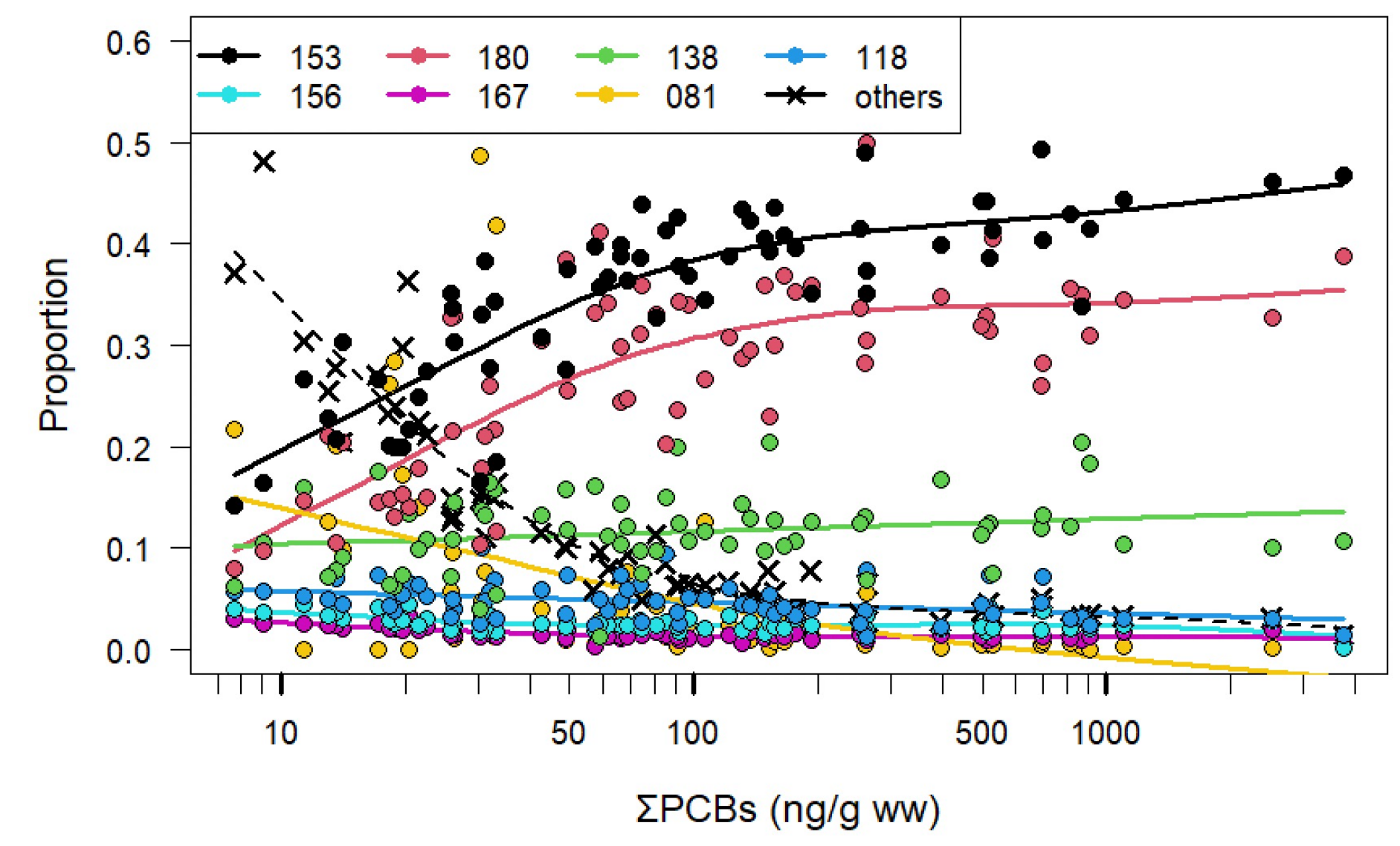

Figure 5. PCB congeners as a proportion of sum PCBs

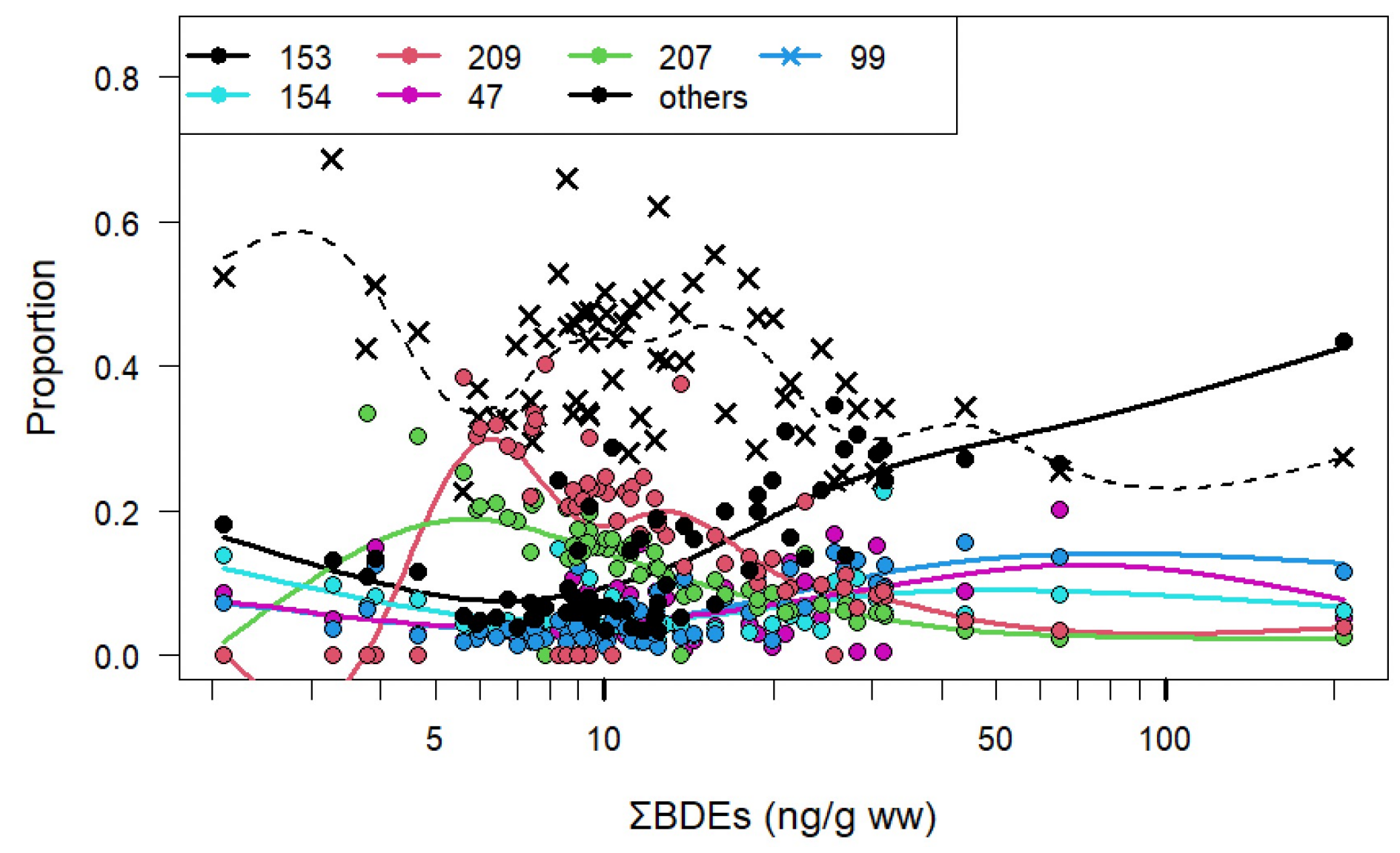

Figure 5. PBDE congeners as a proportion of sum PBDEs

Figure 5 & 6 show PCB congeners as a proportion of ΣPCBs (Fig. 5) and PBDE congeners as a proportion of ΣPBDEs (Fig 6) for the 64 samples. Dominant PCB congeners are almost the same in all countries, e.g. PCB-153, 180, and 138. In contrast, Dominant PBDE congeners vary among the 11 countries. The proportion of the two most dominant PCBs (153 and 180) increases with ΣPCBs, while the proportion of other dominant PCBs (138, 118, 156, 167) remains almost constant regardless of ΣPCBs. No such trend is evident in the proportion of dominant PBDE congeners.

Conclusions

While caution is required in interpreting results due to the small number of samples per year, PCBs and PBDEs show contrasting results. ΣPCBs significantly vary among countries, whereas a long-term significant trend is observed in ΣPBDEs for Italy. Moreover, the composition of PCB congeners in buzzard livers may be independent of countries or years, which is not the case for PBDEs. These findings demonstrate the importance of considering the variety between countries and congeners to estimate the efficacy of risk management measures.

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