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Elemental levels in twenty environmental matrices and temporal trends in normally and declining trees growth from Copsa Mica, Romania

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Modern society faced significant challenges in the last decades as a result of environmental pollution and climate change. The current study's objective was to establish a pattern for assimilating HM in normally and declined *Quercus robur* L. trees. Also, was identify the present state and historical changes in heavy metal elemental composition using different approaches: i) twenty matrices including water, soil, sediments, mushrooms, acorn, leaves, branches, bark and wood; ii) tree-rings elemental time-series trends. Our research of elemental distribution in pedunculate oak earlywood tree-rings brings new viewpoints for investigating chronic decline and dieback using (LA-ICP-MS), (ICP-MS) and (AAS) technics. Impressive amounts of heavy metals in the background environment, especially in water and mushrooms indicate high environmental risk for human health. The Levene's *t*-test shows significant differences (p-value<0.001) between the analysed matrices' heavy metal concentration. Infertile seeds had a superior concentration of metals in acorn core and lower in acorn pericarp and opposite ratio being observed for healthy ones. We noted the above concentration of high susceptibility elements related to past reports in the study area assigned to the climate-induced changes in temperature and evapotranspiration. In our present state of knowledge, is the first study indicating high variability of heavy metals in tree-rings explained through the individual typology of assimilating elements under different phases of trees decline. The Levene's *t*-test shows significant differences (p-value<0.001) between decreased and normally growing ring-width chronologies (EW, LW, and RW) only for 1960-2019. Overall declined, and normally increasing trees coexist in sites with heavy pollution, mentioning those with decline are less sensitive to environmental factors. We noted different patterns of responses to climatic factors for trees affected and unaffected by decline growth. Generally, oak trees correlated significantly with water from the soil and negative with temperature and

evapotranspiration in spring. Also, it can be stated that heavy metals from tree rings indicate a significant relationship with drought effects and trends for several elemental time series increasing after 1980. Heavy metals correlated strongly between theme indicating similar uptake pathways in trees, respectively from the soil and common origins from industrial activities. Changes in the NDVI indices were strongly correlated with heavy metals from tree-rings highlighting the shift in trees phenology induced by decline.

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