

NEUTRON ACTIVATION ANALYSIS FOR ELEMENTAL CHARACTERISATION OF COLLOCATED SOIL, LEAF LITTER AND CENTIPEDE SAMPLES

M. Aničić Urošević¹, B. Mitić², D. Stojanović², M. Popović¹, O. Chaligava³,
P. Nekhoroshkov³ and I. Zinicovskaia³

¹ Institute of Physics Belgrade, University of Belgrade, Belgrade, Serbia

² Institute of Zoology, University of Belgrade – Faculty of Biology, Belgrade, Serbia

³ Frank Laboratory of Neutron Physics, Joint Institute for Nuclear Research, Dubna, Russia

E-mail: mira.anicic@ipb.ac.rs

In temperate deciduous forests, centipedes (members of the arthropod class Chilopoda) can occur at densities exceeding 100 individuals per square metre and play an important role in soil ecosystem functioning and in transferring PTEs to higher-level carnivores in the food chain [1]. In this study, the concentrations of PTEs were determined in centipedes with hemiedaphic *Cryptops anomalans* Newport, 1844 (Can) and euedaphic *Clinopodes flavidus* C. L. Koch, 1847 (Cfl) lifestyles, collected from two woodlands in Serbia: one site near the Smederevo Ironworks, heavily contaminated with red dust (Fe) enriched with As, Cd, Cr, Ni, Pb, and other elements; the other site in an isolated rural area on Mt Vršacke Planine. The centipedes were starved for five days in individual plastic boxes lined with filter paper to allow their gut contents to be voided, while damaged specimens were immediately placed in vials containing 70% alcohol in the field. The aim was to investigate whether these and other PTEs can be detected in the centipedes, as well as in collocated topsoil and leaf litter samples, in measurable quantities and in proportion to their presence in the habitat — that is, the surrounding environment — indicating the level of environmental disturbance. Due to the low sample weights, elemental characterisation (Al, As, Ba, Br, Ca, Ce, Co, Cr, Cs, Cu, Eu, Fe, Ga, Hf, K, La, Mg, Mn, Nd, Ni, P, Pb, Rb, S, Sb, Sc, Sm, Sr, Ta, Tb, Ti, Th, U, V, W, Yb, Zn, and Zr) of centipede samples was performed by inductively coupled plasma optical emission spectrometry (ICP-OES), while soil and leaf litter samples were analysed by instrumental neutron activation analysis (INAA). The preliminary results (Fig. 1) suggest that PTEs accumulated in the samples in measurable quantities, with much higher levels in non-starved centipede samples compared to those starved after collection. The likely reason why the concentrations of PTEs were much higher in non-starved samples is that these elements may be bound in the prey in a form that is insoluble in digestive fluids. A large proportion of the diet of centipedes consists of worms, springtails and woodlice, which store heavy metals in highly insoluble intracellular granules within their digestive tissues. Thus, much of the metal that enters the centipedes through food may remain bound in this form in the gut lumen and be voided in the feces. In addition, both starved centipede samples from the polluted site accumulated approximately the same levels of elements identified as heavy metal pollutants. The exceptions were Cd, which accumulated in significantly higher quantities in Cfl, while Cr was found, to some extent, in higher amounts in Can. Differences in Cd and Cr accumulation between centipede species are mainly due to variations in their physiology, lifestyle, and detoxification efficiency. Some species are high accumulators, while others maintain significantly lower concentrations, even in the same environment. Finally, the centipede samples from the unpolluted site, which were non-starved, had PTE concentrations at the same level as the starved samples from the polluted site.

- [1] B.Mitić, S.Borković-Mitić, A.Stojsavljević, D.Stojanović, S.Pavlović, L.Vasiljević, N.Ristić (2022). Metal and metalloid bioaccumulation in three centipedes (Chilopoda). Arch. Biol. Sci. 74, 207-215.

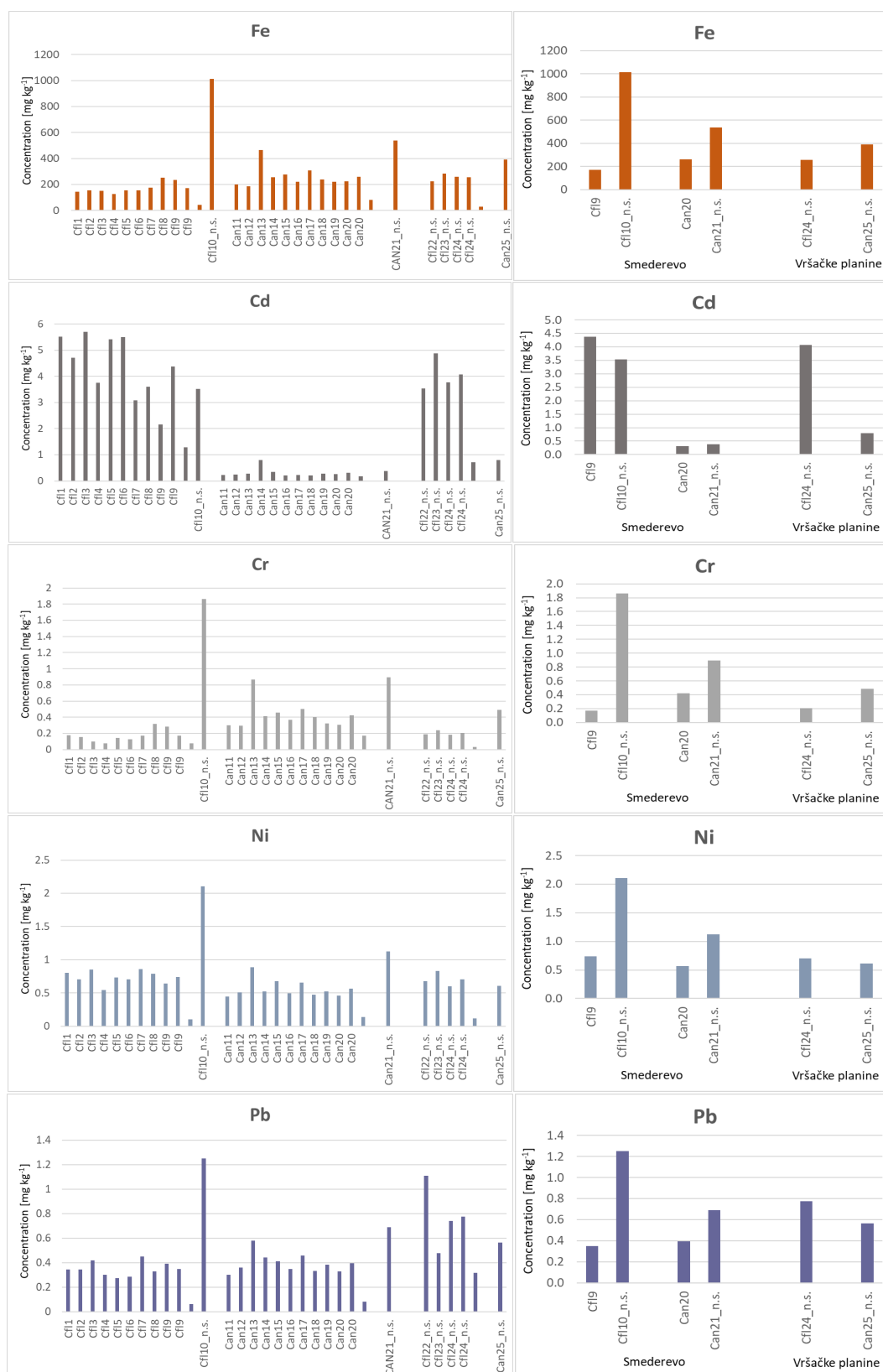


Figure 1. Left: Concentrations (mg kg⁻¹) of heavy metals Fe, Cd, Cr, Ni, and Pb in two centipede species: *Clinopodes flavidus* (Cf1) and *Cryptops anomalans* (Can). Right: Average concentrations of the elements per species at polluted (Smederevo) and unpolluted sites (Mt Vršačke Planine). n.s. — non-starved specimens.