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The effect of inundation frequency on ground beetle communities in a channelized mountain stream

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Under natural conditions, river channels and floodplains are shaped by flow and sediment regime and are one of the most dynamic ecosystems. At present, European river floodplains are among the most endangered landscapes due to human modifications to river systems, including channel regulation and floodplain urbanization, and land use changes in the catchments. Situated in a transition zone between terrestrial and aquatic environments, exposed riverine sediments (ERS) play a key role in the functioning of riverine ecosystems. This study aimed to verify whether the bare granular substrate is the only factor responsible for sustaining the biota associated with ERS or the inundation frequency also plays a role, modifying the potential of particular species to colonize these habitats. Ground beetles (Col. Carabidae) were selected as the investigated group of organisms and the study was carried out in Porębianka, a Polish Carpathian stream flowing through both unconstrained channel sections and sections with varied channelization schemes (rapid hydraulic structures, concrete revetments or rip-rap of various age). In each of the distinguished channel types, four replicates of 10 pitfall traps were established in three rows varying in distance to the mean water level (at three different benches). Almost 7000 individuals belonging to 102 species were collected on 60 plots. Forward selection of redundancy analysis revealed four factors significantly describing the variation in ground beetle species data: bank modification, potential bankfull discharge, frequency of inundation and plant height. Most of the biggest species were ordered at the positive site of first axis having the highest values of periods between floods. Total biomass of ground beetles and mean biomass of individuals differed significantly between sites of various frequency of inundation, whereas the variation in abundance and species richness of ground beetles was independent of the river dynamics. The body size distribution of ground beetles is significantly right skewed on more frequently flooded areas whereas on more stable localities it becomes left skewed. Our results also demonstrated that the presence of ERS does not changes the structure of ground beetle communities if the frequency of inundation of river banks is reduced. This study indicated that not only habitat parameters but also biotic interactions between competing species from a regional pool are important for the conservation of riverine communities. Vulnerable beetles characteristic of riverine habitats are small and usually weak competitors. A reduced frequency of bank inundation creates possibilities for the colonization of ERS by species from surrounding habitats and elimination of the species well adapted to the dynamic flow conditions typifying unmodified stream sections.