



BLACK RAIN ACROSS REGIONS: ATMOSPHERIC TRANSPORT OF WILDFIRE POLLUTANTS DRIVES FUNCTIONAL RESPONSES IN A NEOTROPICAL SHREDDER

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Introduction: Wildfire-derived aerosols can be scavenged by precipitation, generating “black rain” enriched with particulate matter, trace metals, and organic contaminants that may disrupt aquatic ecosystem functioning. Here, we characterized the physicochemical composition of post-fire rainwater associated with extreme wildfire events in southeastern Brazil (August to September 2024), whose atmospheric emissions were transported to southern Brazil, and evaluated its sublethal effects on larvae of the shredder *Phylloicus* sp (in September 2024). We hypothesized that black rain would induce compensatory feeding while reducing biomass due to increased metabolic costs associated with detoxification and osmoregulation. **Methodology:** Black rain samples were collected in southern Brazil and analyzed for particulate matter (gravimetry), trace-metals (ICP-MS), and organic-compounds (GC-MS). *Phylloicus* larvae were individually incubated in microcosms (18 °C, 7 days) under a gradient of black rain dilution (0, 25, 50, 75, and 100%), corresponding to 0–42 mg L⁻¹ of particulate matter. Response variables included leaf consumption, case-building investment, biomass change, and leaf microbial decomposition, were analyzed using effect size metrics. **Results and discussion:** Black rain exhibited high particulate loads (42 mg.L⁻¹) and was dominated by phthalates (82.1%), particularly di-(2-ethylhexyl) phthalate (DEHP; 79.2%), indicating plastic combustion presence. At 100% concentration, leaf consumption increased by 40%, whereas larvae biomass declined, revealing a decoupling between feeding activity and growth. At 75%, case-building increased (15%) without biomass loss, suggesting a defensive allocation strategy that limits contaminant uptake. Microbial leaf decomposition was inhibited at lower concentrations (25–50%) but stimulated at higher levels (75–100%), likely due to nutrient inputs from ash altering detrital quality. **Conclusions:** Our findings demonstrate that black rain imposes multiple stressors that trigger compensatory feeding and energy reallocation in shredders, with cascading effects on decomposition processes. These results highlight wildfire-derived atmospheric deposition as an overlooked driver of trophic dynamics and ecosystem functioning in freshwater systems.

Keywords: *Black rain; Chemical composition; Pollution; Aquatic invertebrates; Feeding activity.*