Mercury Exposure in Two Fish Trophic Guilds from Protected and ASGM-Impacted Reservoirs in Zimbabwe and Possible Risks to Human Health

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Abstract

Despite a surge in mercury (Hg) pollution from artisanal and small-scale gold mining (ASGM) in Zimbabwe's drainage basins, little is known about Hg trophodynamics in the country's major reservoirs. We analyzed fish tissues for total mercury (THg) and stable isotopes of nitrogen and carbon ($\delta^{15}N$ and $\delta^{13}C$) to compare patterns of biomagnification between two trophic guilds from a protected reservoir (Chivero) and an ASGM-impacted reservoir (Mazowe) and assessed consequences for human and fish health. Mean dry weight THg concentrations were significantly higher for both piscivorous and herbivorous fishes from Mazowe reservoir compared to fishes from similar feeding guilds in Chivero. Trophic magnification slopes (TMS), inferred from linear regressions between $\log_{10}$[THg] and $\delta^{15}N$, revealed significant Hg biomagnification in Mazowe (TMS = 0.28; $p < 0.05$) and no evidence for Hg biomagnification in Chivero (TMS = − 0.005; $p > 0.05$). In Mazowe's piscivorous fishes, 32% had wet weight THg concentrations that surpassed 0.2 µg/g ww, a threshold for susceptible human populations and biochemical and gene expression alterations in fish. In addition, 17% of Mazowe's piscivorous fishes surpassed the UNEP THg toxicity threshold for human consumption (0.5 µg/g ww). To reduce exposure to Hg toxicity in humans, the maximum fish consumption for piscivorous species from Mazowe reservoir should not exceed 431 g/week for both adult male and female consumers. Our findings demonstrate the importance of creating freshwater-protected areas to prevent direct Hg contamination of aquatic ecosystems and the need for health agencies to provide fish consumption advisories to vulnerable communities.