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Biodiversity - 2015: Toxicity of heavy metals and effect of their concentrations on biological productivity and diversity in freshwater ecosystem

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Abstract

Modern technology uses heavy metals both in the elemental and combined forms . During recent years serious concern has been voiced about the deteriorating state of fresh water bodies with respect to trace metal pollution. Heavy metals have the potential to be toxic to living organisms, if present at a level above a threshold. The metal concentrations are routinely monitored using biomonitoring species, which accumulate heavy metals in their tissues and may therefore be analyzed as a measure of the bioavaliability of metals in the ambient habitat. Low salinity which is unique to fresh water systems is known to increase the bioavalabilities of metals and this may increase metal bioavailabilities at sites with low metal concentrations. Changes in pH can induce significant effects on the partitioning of metals between dissolved and particulate phases as well as on their speciation in each of these phases. It is recognized that in freshwater systems trace metals have high pollution potential that could be measured through the use of fish. A number of human activities have been identified through research to impact on biological productivity in fresh water ecosystems either positively or negatively. Some of such activities include dredging, petroleum exploration and production, road and bridge construction, urbanization, indiscriminate use of fertilizers and pesticides on agricultural lands, industrialization, indiscriminate waste dumping and filling of wetlands, amongst others. According to Oribhabor, human activities have great impacts on biodiversity in the Nigerian aquatic ecosystems. His work revealed that the impact can be brought about through persistent threat by heavy metals and eutrophication, amongst others. The work of Moslem and Miebake on the effect of dredging on plankton community of Orashi River in the Niger delta, Nigeria showed that nutrient levels downstream of the dredger position had higher influence on the plankton community than the dredging induced-increase in turbidity and total suspended solids.

This present research on the toxicity of heavy metals and effect of their concentrations on biological productivity and diversity in freshwater ecosystem was designed using three heavy metals (Cu, Fe, Pb) separately, to show the effect of these metals on biological productivity in a static simulated study. Toxicity of copper (Cu), iron (Fe) and lead (Pb) to tilapia fish was conducted using the simple arithmetic graphic method. In each experiment, a control (distilled water) and graded concentrations of the test metals were used. Observations for fish mortality and subsequent removal of dead fishes were made hourly for 4 days. Percent mortality was calculated for each of the heavy metals and 96-hr LC50 for Cu, Fe and Pb for tilapia fish were determined to be 0.44 mg/l, 0.96 mg/l and 2.85 mg/l, respectively. Of interest was the result obtained on biological productivity in the Aquaria containing 2.85mg/l of Pb within

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seven (7) days from the start of the experiment. This was repeated for each of the heavy metals. The test lasted for 96 hrs. From the observations made, it was possible to select four concentrations for the heavy metal toxicity studies. Cu, Fe and Pb heavy metals were used in static simulation studies. Mortality and toxicity studies were each carried out for 96 hours. The period for the toxicity studies was extended to 168 hours (7 days). Test solutions were observed for any effect due to the heavy metals in solution. The test was also extended for 14 days for observed effects to be more obvious. Biological productivity and thus high diversity were observed in the case of Cu and Fe when the period was lengthened to fourteen (14) days. As against scientific believe that Pb is highly toxic to humans, this study showed that Pb pollution in a freshwater ecosystem encourages high rate of biological productivity and thus high diversity; thus confirming that heavy metals have differing effects on biological productivity and diversity in the ecosystem. Lead (Pb), whose response is dictated by the dose which may depend on mobility and bioavailability, was therefore identified by this work as a trigger factor to eutrophication. Heavy metals support biological productivity in fresh water ecosystems and the degree differs from one metal to the other as was evident in the study. Regular bioassay, a test involving living tissues should be conducted in organisms or groups of organisms to determine the potency of any physiologically active substance of unknown activity. These tests have been used to ascertain effects such as toxicity, bioaccumulation, histopathology, growth rate, mutagenicity, embryo toxicity and teratogenicity.

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