

Use of Locomotor Activity of Rainbow Trout Juveniles in Identifying Sublethal Concentrations of Landfill Leachate

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Abstract : Landfill waste is a common problem as it has an economic and environmental impact even if it is closed. Landfill waste contains a high density of various persistent compounds such as heavy metals, organic and inorganic materials. As persistent compounds are slowly-degradable or even non-degradable in the environment, they often produce sublethal or even lethal effects on aquatic organisms. The aims of the present study were to estimate sublethal effects of the Kairiai landfill (WGS: 55°55'46.74", 23°23'28.4") leachate on the locomotor activity of rainbow trout *Oncorhynchus mykiss* juveniles using the original system package developed in our laboratory for automated monitoring, recording and analysis of aquatic organisms' activity, and to determine patterns of fish behavioral response to sublethal effects of leachate. Four different concentrations of leachate were chosen: 0.125; 0.25; 0.5 and 1.0 mL/L (0.0025; 0.005; 0.01 and 0.002 as part of 96-hour LC50, respectively). Locomotor activity was measured after 5, 10 and 30 minutes of exposure during 1-minute test-periods of each fish (7 fish per treatment). The threshold-effect-concentration amounted to 0.18 mL/L (0.0036 parts of 96-hour LC50). This concentration was found to be even 2.8-fold lower than the concentration generally assumed to be "safe" for fish. At higher concentrations, the landfill leachate solution elicited behavioral response of test fish to sublethal levels of pollutants. The ability of the rainbow trout to detect and avoid contaminants occurred after 5 minutes of exposure. The intensity of locomotor activity reached a peak within 10 minutes, evidently decreasing after 30 minutes. This could be explained by the physiological and biochemical adaptation of fish to altered environmental conditions. It has been established that the locomotor activity of juvenile trout depends on leachate concentration and exposure duration. Modeling of these parameters showed that the activity of juveniles increased at higher leachate concentrations, but slightly decreased with the increasing exposure duration. Experiment results confirm that the behavior of rainbow trout juveniles is a sensitive and rapid biomarker that can be used in combination with the system for fish behavior monitoring, registration and analysis to determine sublethal concentrations of pollutants in ambient water. Further research should be focused on software improvement aimed to include more parameters of aquatic organisms' behavior and to investigate the most rapid and appropriate behavioral responses in different species. In practice, this study could be the basis for the development and creation of biological early-warning systems (BEWS).

Keywords : fish behavior biomarker, landfill leachate, locomotor activity, rainbow trout juveniles, sublethal effects

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