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Total suspended solids (TSS) adverse effect level to malaysian mahseer (tor tambra)

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Abstract:

Total suspended solids (TSS) as other contaminants could cause adverse effects to fish if present at an excessive level. To date, Malaysia does not have any specific standard on TSS limits for freshwater community protection, especially fish. This study was conducted to determine the non-adverse effects level of TSS to the Malaysian mahseer (*Tor tambra*). The stress test was undertaken using the Multispecies Freshwater Biomonitor (MFB™) (eight test chambers) for 24 hours exposure with ten-minute intervals. The stress signal was observed on behavioural responses that were ventilation and locomotion. Fifty juveniles ranging from 5cm to 7cm standard length were collected from natural ecosystems and exposed to thirteen series of TSS concentrations (50 mg/L, 100mg/L, 150 mg/L, 200 mg/L, 250 mg/L, 300 mg/L, 400 mg/L, 500 mg/L, 600 mg/L, 700 mg/L, 800 mg/L, 900 mg/L and 1000 mg/L) in closed circulated system in the laboratory. A total of 13,104 observations were recorded during continuous 24-hour experiments. The same species from similar locations where test species were collected were caught for quality of growth assessments using length-weight analysis. Laboratory result indicates more time was used for locomotion from ventilation, however, ventilation has a more significant coefficient of variation when exposed to a stressor. One-sample t-test indicates insignificant different time used for locomotion and ventilation compared to control ($p = 0.987$ and 0.974 respectively, $\alpha = 0.05$) for 50 mg/L to 500 mg/L. However, the time used for behaviour was significantly changed at 600 mg/L TSS concentration, where low-frequency (locomotion activity) was reduced but high-frequency activity (ventilation) increase was increased significantly. Gill flaring or coughing activity was observed at 600 mg/L for TSS removal from their gill membrane and was more frequent at higher TSS concentrations. The TSS concentration in the studied river (where the fish were caught) was found to fluctuate ranging from 7.3 mg/L during no rain to 957 mg/L during or after rain. Length-weight analysis of field captured *Tor tambra* shows

negative allometric growth patterns ($b < 3.0$), which indicates inconvenience growth conditions. Since almost similar TSS range of concentration was tested in the laboratory, inconvenience growth could be displayed by a significant ventilation change. Gill flaring proves the species experience inconvenience conditions due to excessive TSS and the result from this study is very useful for Tor tambra protection. This study reveals the lowest TSS cause adverse effects Tor tambra grow is 600 mg/L. This value is useful as a benchmark for the maximum TSS allowable in the river that receives impact from any development. Therefore, the government may enforce this limit in EIA approval conditions to protect Malaysian endangered Mahseer (Tor tambra).

Keywords:

Freshwater biomonitoring, biological indicator, length-weight analysis, fish stress signal