Variability of fish population responses to multiple stressors

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Abstract

Aquatic organisms face multiple challenges in human-altered rivers such as abiotic (e.g. contamination) and biotic (e.g pathogens) stressors. Defense mechanisms against these stressors are likely to interact strongly but their interacting effects are still understudied, hindering our ability to predict the responses of wild populations to multiple stressors. In addition, recent studies bring very variable results depending on the populations and biological level of organization studied. In this study we hypothesized that populations of fish would display contrasted sensitivity to stressors depending of their past history in their natural environment (local adaptation). More specifically, we tested: i) how an experimental exposure to trace metals could affect the response of wild fish across biological levels (immunity, body condition, behavior) And, ii) how the past history of exposure to metal pollution would affect their plastic responses to the experimental contamination? To address these questions we selected 5 wild populations of gudgeons (Gobio occitaniae) along a contamination gradient of trace metal elements (TM's) in the Garonne watershed. Fish immune and behavioral responses were measured throughout exposure to an environmentally relevant mixture of TM's (Cd, Cu, and Zn) and standardized antigen injection mimicking a parasite attack (full factorial design).

We predict that the exposure to combined immune and contaminants stressors would influence mostly labile traits such as behavior and physiology through shifts in energy allocation for investment in detoxification process and immune responses, which could lead to immunotoxicological effects. We also predict that populations originating from the most contaminated areas will be better able to cope with the experimental contamination than control unpolluted populations. Such studies will improve our understanding of the high variability in sensitivity to contamination observed in wild populations and will help anticipating the effects of human-induced stressors in aquatic organisms.

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