Combined effects of global warming and microplastic exposure from individual to populational levels of a benthic copepod

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Abstract

Global warming and plastic pollution are two human-induced environmental stressors of concern which affect aquatic organism and ecosystems, but their combined effects are not yet clarified. Furthermore, the microplastics effects at organism level are currently being widely investigated, but the effects at population level, particularly in combination with other environmental stressors such as increased seawater temperatures, are unknown. Therefore, our goal was to assess the combined effects of microplastics exposure and temperature increased in the benthic copepod *Nitokra spinipes*, at organism level to, and then to further investigate their population dynamics. To do so, we first exposed the harpacticoid copepod *N. spinipes* to Poly(lactic-co-glycolic) acid (PLGA) microbeads (5μm), at control (22◦C) and increased water temperatures (+3◦C, as per the RCP8.5-IPCC emissions scenario). First, the effects on *N. spinipes* individuals were assessed by identifying shifts on the filtration rate, a proxy for energy assimilation. Then, based on the observed filtration rates, we simulated their population dynamics under the projected +3◦C, while exposed to microplastics, using an individual-based model implementation of the dynamic energy budget theory (DEB-IBM). All *N. spinipes* treatments at 25◦C had a significantly higher filtration rate (64.1±41.5 nL/indiv/min) compared to the treatments at control temperature (22◦C) (10.4±9.6nL/indiv/min). Our results further indicate that at 25◦C treatments, exposure to PLGA microbeads at 0.1% food content induced a significant decrease in the filtration (41.7±23.9nL/indiv/min) of *N. spinipes*, when compared to no microplastics exposure (103.3±37nL/indiv/min). Using a DEB-IBM, we estimated that the population equilibrium density would decrease by 50% at 25◦C when the PLGA microplastics concentration would be 0.009% of the food content. Our study demonstrates that the combined exposure of microplastics and elevated water temperatures can induce less energy assimilation and inform on the vulnerability of marine populations under current and future environmental conditions.

Keywords: Microplastics, population effects, DEB model, global warming, multiple stressors

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