The influence of ecological complexity on the rate of adaptation across microorganisms: insights from a meta-experimental evolution approach by the ExpEvolOcc network

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Résumé

With ongoing climate change and alteration of habitats, the co-occurrence of different stressors is the new norm worldwide. Rapid adaptation might help organisms respond to abrupt shifts in multiple aspects of their environments. However, while the speed of evolutionary changes in response to single stressors has been widely considered, we still know little about adaptation to multiple stressors. Is adaptation slowed because of the cost of complexity, or accelerated because of a broader genomic target? This is particularly relevant for microorganism, as such modifications can impact their eco-evolutionary dynamics, which can scale-up and cascade to their whole ecosystem. The ComplexAdapt consortium was built with the aim to fill this gap, by bringing together 15 research group (ExpEvolOcc network).

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Using a meta-experimental evolution approach, we investigated how the complexity of ecological challenges affect adaptive evolution across a diverse set of model microorganisms (viruses, bacteria, protists, fungi, microalgae), thus potentially uncovering general patterns. Each participating group assayed the initial reduction in fitness (population growth at low density) of the ancestor, following transfer to single and multiple stressor environments (e.g., temperature, salt, copper and antibiotics). Following several cycles of transfer and regrowth, the organisms were finally assayed for fitness changes in their own evolutionary treatment, and in the original control conditions.
Preliminary results suggest greater evolutionary fitness changes in response to single compared to multiple stressors, or to control populations in benign environments. Organisms tended to exhibit little evolutionary responses to salt stressor treatments than other stressors. Further, populations evolved under single stressors show no evident fitness costs when re-exposed to their original control conditions. Although these results could suggest that environmental complexity is a constraint on the rate of adaptation, they need to be corrected for the fact that multiple stress may lead to a stronger initial fitness reduction.

Mots-Clés: Experimental evolution, adaptation, stress, climate change, eco, evolutionary dynamics, fitness