Resistance and resilience of microbial communities – temporal and spatial insurance against perturbations

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Bacteria are fundamental components of aquatic ecosystems. Their activity sustains the transformation and cycling of elements such as Carbon, Nitrogen and Phosphorus. For instance, lake bacteria are crucial for the mineralisation and transfer of dissolved organic matter to higher trophic levels.
All ecosystems are bound to experience perturbations and studies on resistance and resilience of microbial communities against disturbances are scarce. Resistance in this context means that a community will be able to withstand a disturbance and not change in composition or function. Resilience, on the other hand, implies that a community is affected by the disturbance but can recover from the latter. An understanding of the factors and mechanisms involved that might enhance resistance and resilience of particular communities can be particular useful to manage the impacts of perturbations in order to preserve important ecosystem processes.

The aim of this study was to investigate how the provision of two types of refuges (temporal and spatial) might influence the resistance and resilience of complex microbial communities against a salinity pulse perturbation. The temporal refuge was achieved by the provision of a surface for colonisation whereas spatial refuge was achieved by dispersal from an undisturbed regional pool. We hypothesised that the temporal and spatial refuges will positively influence the recovery of the bacterial community in terms of composition and functioning after being disturbed.
To address these questions, we installed a continuous cultivation system and measured bacterial functional parameters like cell numbers, substrate utilisation and respiration while the community composition was analysed using a DNA based fingerprinting technique.

The salt pulse perturbation was found to affect both bacterial functioning and community composition. Moreover, our results indicate that refuges can enhance resilience and influence resistance of bacterial communities. It was observed that functioning recovered within a week, while community composition reacted differently for the two refuges. Community composition in the spatial refuge was less affected by the disturbance whereas in the temporal the community composition was more affected but also showed signs of recovery compared to the treatment lacking a refuge.

We hope that our work stimulates further research about the importance of different kinds of refuges against perturbation, especially for preserving important ecosystem processes and diversity.

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