Biodiversity increases the forecastability of species abundances in changing environments

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Résumé

Good ecological forecasting is important for ecosystem conservation and management policies that address climate change and biodiversity loss. Yet, forecasting ecological dynamics is challenging, likely because of the complexity of species networks and non-linear responses to environmental change. However, the relation between complexity and forecastability has never been tested with an experimental manipulation of complexity (e.g. biodiversity) and only a few empirical studies have investigated how environmental change influences ecological forecasts. Here, we carried out a unique and long term (123 timepoints, 41 weeks) microcosm experiment to explore the effect of biodiversity and environmental change on the forecastability of ecological dynamics. With a pool of 18 taxa, we assembled 15 different communities over three levels of species richness (7, 10, 14 species). We exposed all communities to both constant and gradually declining light, a relevant environmental variable currently undergoing directional change due to anthropogenic pressure. We recorded species abundances and the ecosystem properties community biomass and dissolved oxygen. We forecasted these three measures using a suite of different data driven forecasting methods to test the hypotheses that higher biodiversity (i.e. complexity) lowers forecast skill and that directional environmental change decreases forecastability due to novel system states. We found that at low biodiversity forecasts were indeed worse in the changing light conditions. However, with increasing species richness forecasts improved in the changing environment, eventually outperforming forecasts done in the constant environment (which were unaffected or worsened). This pattern could partially be explained by changes in the temporal stability and autocorrelation of the time series, which were influenced by both species richness and light conditions. Our results suggest that while biodiversity might promote forecastability in changing environments, the combination of species loss and global change could make populations particularly unpredictable. Considering current biodiversity loss and environmental changes, this may pose an additional challenge to ecological conservation.

Mots-Clés: Biodiversity, Environmental change, Climate change, Ecological forecasting, Microcosm experiment, long, term time series, Community ecology, Freshwater ecology, Protists

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