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Green Water and Natural Ecosystems under Global Change

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Abstract

Scenarios of global change have fostered many studies which attempt to predict species response to climate change based on bioclimatic envelopes. These studies assume that species may simply shift their distribution when climate changes. However, such an approach completely neglects the ecological context of a species. Therefore, mechanistic studies are needed which address both responses of populations and entire communities to global climate change.

Here, we present an interdisciplinary study within the project GLOWA Jordan River which has been designed to predict the response of Eastern Mediterranean ecosystems to climate change at the level of species, communities, and landscapes. To this end, we regard ecosystems as users of 'green water' and model their response to changes in green water availability. We combine detailed field studies on soil and vegetation in naturally and experimentally varying climates with ecological modelling and socio-economic studies. Namely, we compare ecological processes along a steep climatic gradient ranging from extreme desert to humid Mediterranean conditions, and we manipulate annual rainfall at two of the stations. Spatially-explicit models integrate field data and downscaled climate scenarios for predicting the long-term response of ecosystems to climate change. Models are coupled both with models of climatic scenarios as well as with models of green water availability.

Our modelling studies indicate that changes in rainfall variability may have more drastic consequences for extinction probabilities of plant species than changes in amount of annual rainfall. In addition, our results suggest that transitional ecosystems may be the most vulnerable to climate change. Semi-arid ecosystems were most sensitive to erosion and to extinction of selected annual plant species. Since our socio-economic studies have shown that mitigation costs of climate change effects may be relatively low for those ecosystems, we suggest that management efforts should focus primarily on semi-arid regions.

Keywords: Eastern Mediterranean, ecosystems, global change, GLOWA Jordan River, Israel