Plant communities in Holy Land can cope with climate change of 'biblical' dimensions

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An international research team comprised of German, Israeli and American ecologists, including Dr. Claus Holzapfel, Dept. of Biological Sciences, Rutgers University-Newark, has conducted unique long-term experiments in Israel to test predictions of climate change, and has concluded that plant communities in the Holy Land can cope with climate change of "biblical" dimensions. Their findings appear in the current issue of *Nature Communications*.

When taking global climate change into account, many scientists predict dire ecological consequences around the world. The Middle East in particular has been thought to be vulnerable, since east Mediterranean ecosystems not only are hotspots of biodiversity, but also contain many of the wild ancestors of important crop plants and therefore harbor a rich genetic reservoir for them.

In a region with the lowest per-capita water availability, rainfall is predicted to decrease further in the near future, and could spell extreme hardship for the function of these unique ecosystems and possibly endanger the survival of important genetic resources.

For nine years the research team of German, Israeli and American ecologists subjected extremely species-rich plant communities to experimental drought designed to correspond to predicted future climate scenarios. For this, the study used four different ecosystems aligned along a steep, natural aridity gradient that ranges from extreme desert (3-4"annual rainfall) to moist Mediterranean woodland (32").

The recently published study demonstrates that in contrast to predicted changes, no measurable changes were seen in the vegetation even after nine years of rainfall manipulations. None of the crucial vegetation characteristics, neither species richness and composition, nor density or biomass - a particularly important trait for these ecosystems traditionally used as rangelands - changed appreciably in the rainfall manipulations.

These conclusions were reached regardless of whether the sites were subjected to more or less rain.

"Based on our study, the going hypothesis that all arid regions will react strongly to climate change needs to be amended," stated Dr. Katja Tielbörger (University of Tübingen in Germany), the lead author of the study.

One of the reasons for the high resilience of the ecosystems studied is likely the high natural variability in rainfall for which the region has been known throughout history. The climate scenarios tested included a decrease of rainfall to about 30% of the current values. That amount of rainfall seems to fall within the natural "comfort zone" of wild-growing plants. Archeological sources (and similar descriptions in the Bible) speak of such dramatic variation in climate over the course of centuries.

The team of scientists implemented a novel experimental approach in which irrigation and rain-out shelters were used not only to compare plots with changed climate within a site with un-manipulated controls, but the placing of sites along the steep aridity gradient also allowed testing the long-standing assumption that with climate change, species will track their climate zone and their ranges will simply shift.

Such shifts, commonly assumed by numerous climate-envelope models, have now for the first time been scientifically tested and have not been confirmed.

"Our experiment is likely the most extensive climate change study ever done, because of the number of sites involved, the long duration of experimental manipulations, and the immense species richness", stated Dr. Claus Holzapfel of Rutgers University-Newark, adding: "These facts add to the robustness of our results."

The study serves to decrease the "doomsday" scenario of climate change for the arid Middle East, despite the fact that the conclusions reached by the research team are only applicable to the specific regions studied. The authors of the study caution that these results should not be used to address global issues of climate change. However, the researchers maintain that their results are important for understanding and countering specific consequences of climate change in the Middle East.

More information: Katja Tielbörger, Mark. C. Bilton, Johannes Metz, Jaime Kigel, Claus Holzapfel, Edwin Lebrija-Trejos, Irit Konsens, Hadas A. Parag, Marcelo Sternberg: Middle-Eastern plant communities tolerate nine years of drought in a large-scale climate change experiment. *Nature Communications* Oct. 2014 www.nature.com/ncomms/2014/141 … 2/pdf/ncomms6102.pdf

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