Session 1.1: Climate change

ASSESSING THE VULNERABILITY OF RANGELAND ECOSYSTEMS TO GLOBAL CLIMATE CHANGE IN THE DRYLAND AREAS OF THE MIDDLE EAST AND NORTH AFRICA REGION

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Rationale

Climate change projections provide little information on how this risk might affect rangeland plant communities in specific regions. Rangelands are by far the most widespread land use type in the dry areas, and are home to most of its poorest inhabitants. Having low productivity and potential, the people they support remain largely marginalized. A large area of the Middle East and North Africa (MENA) region is arid or semi-arid with shallow and low fertility soils and poor plant cover and pastoral/agro-pastoral use are dominant production systems.

This study evaluated the impact of climate change on the geographical distribution of selected native rangeland species in the MENA region. Assessments of the potential impact of climate change on the geographical distribution of two economically important species, *Salsola vermiculata, Atriplex leucoclada* (Boiss) in comparison to *Haloxylon salicornicum* (Moq.) and *H. schmittianum*, non-palatable species, in the MENA region was conducted.

Methods used and partnership set up

The ecological niche concept (Phillips et al. 2006) expressed by the occurrence of the rangeland community or species in relation to its environmental requirements, was applied. The species distribution modeling software MaxEnt (Maximum Entropy) was considered the most suitable model. An ecologically-based quantitative niche model was developed to assess the vulnerability of selected species to climate change scenarios. Model input values included the occurrence (spatial location) of individuals from the target species in relation to eight climatic variables (GIS layers), three soil property layers, one altitude layer, and one grazing pressure layer. Climatic variables included in the study varied across three time periods; current year, 2020 and 2050.

Climatic projections, using the same eight variables as the current situation, were achieved for the years 2020 and 2050 using the average of predictions of the widely used global circulation model HADCM3, within the frame of the A2 scenario of CO2 emissions (IPCC 2000).

Since environmental parameters only enable assessing the sensitivity of target species to climate change, the use of socioeconomic parameters describing the human pressure is necessary to assess the species vulnerability (O'Brien et al. 2004). In this case grazing is the main common use in the MENA region. Consequently, the socioeconomic layer was represented by a synthetic variable called the Coefficient of Overgrazing (CO), which aims to estimate the current state of the species in relation to animal pressure (i.e. species are overgrazed, moderately grazed or under grazed).

Results

The results of the study validate the common belief that desired rangeland species reductions will likely occur with the combined effect of climate change and anthropogenic influences. This combination has the potential to shift environmental conditions that favor the establishment of the unpalatable species and eliminate range species that are found within the host ecosystem. Furthermore, the results indicated that threatened species showed high vulnerability to climate change. However, species with low palatability and broad ecological niches had an advantage due to the reduced competition for water and nutrients.

In the study areas, *S. vermiculata* and *A. leucoclada* were apparently highly vulnerable to ongoing climate change combined with human pressure, i.e. grazing. The main environmental variables restricting the geographical distribution of these key species were the variation of seasonal temperatures followed by mean annual precipitation. The precipitation of the wettest month (15–18 %) was the third most important limiting variable. The socioeconomic variable (i.e.

CO) contributed 11%, and seemed to enhance the former climatic parameters' impact on the species' resilience capacity. *Salsola vermiculata* is a highly palatable range species and continuously threatened by overgrazing. Unlike *S. vermiculata* the model outputs showed an important invasion of study areas by *Haloxylon spp.* by 2020 and even more so in 2050. It is apparent that the ongoing climate change will favor these species and lead to ecological conditions similar to those required for their establishment and growth. The mean annual precipitation was the main factor explaining these trends with 55–60 % contribution. Decreased rainfall will enhance invasion of the study areas by these Haloxylon spp. Temperature seasonality (14.6–16.4 %) and minimum temperature of the coldest month (10.2–13.5 %) came in second and third, respectively. Together these three parameters explained 80–90 % of the expected geographical distribution of these species. Moreover, *Haloxylon spp.* apparently had greater tolerance for warmer and drier conditions.

Outcomes

Land managers and development projects are well equipped to better monitor, assess and manage their natural resources and in particular arid and semi-arid rangelands. The suggested protocols and tools provide valuable information for assessing the impact of climate change, livestock/wildlife grazing, and spread of degradation/desertification rates. If utilized correctly, such information can improve rural community livelihoods by mitigating possible negative trends.

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