





Jabal Moussa: a global significant forest landscape in the Middle East

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Hiking (© P. Regato)

Jabal Moussa forms a very genuine karstic landscape, with a remarkable geological, biological and cultural heritage, justifying its recent designation as a Biosphere Reserve.

A key biodiversity area of global significance

Its complex topography, formed by the dissolving of calcareous rocks, results in a network of narrow and deep gorges separating mountainous elevations with a “pavement” of clints and grikes, isolated and undercut pinnacles of limestone, closed depressions, subterranean drainage, and caves. Karst landscapes represent many of the world’s most productive aquifers, a fact which becomes especially relevant in the Mediterranean region, characterised by a chronic water deficit. Therefore, the protection of Jabal Moussa represents a major step to secure the scarce water resources in the region, and a great opportunity to raise public awareness about the role of karstic mountains and forests to maintaining clean and reliable water resources, especially critical under current climate change trends.

The wealth of plant species and forest ecosystems found in Jabal Moussa forests has been recognized by experts as one of the main features that distinguishes this Biosphere Reserve as a key biodiversity area of global significance. Among the most salient features, we can highlight:

- The presence of a fairly large number of forest trees and habitats.
- The pronounced plant endemism of the area.

The presence in this area of edge and isolated populations of tree species, finding there its southernmost distribution limits, such as *Juniperus drupacea*, *Quercus pseudocerris*, *Ostrya carpinifolia*, as well as some representatives of *Acer* and *Sorbus*.

The presence in this area of a significant number of northern Mediterranean and Euxinian species, which may be regarded as relics of more humid vegetation during palaeo-times, such as *Rhododendron ponticum* and *Ostrya carpinifolia*.

Preserving and enhancing diversity

In fact, Jabal Moussa still maintains a very healthy and highly diverse forest landscape, becoming a remarkable exception in such a deforested region like the Middle East. In general terms, healthy Mediterranean forest stands are characterised by high levels of genetic and species diversity, ensuring a higher forest adaptability and tolerance to environmental changes and disturbances.

IUCN considers that preserving and enhancing diversity at all levels (genetic, plant, habitat and landscape diversity) is the best option to increase the resilience and reduce the vulnerability of ecosystems and people. Ecosystem-based adaptation integrates the use of biodiversity and ecosystem services into an overall adaptation strategy to help people to adapt to the adverse impacts of the combined effects of socio-economic and climate changes.



Cyclamen (© P. Regato)

After the important efforts undertaken for the designation of Jabal Moussa as a Biosphere Reserve, it is urgent to stop and reverse the existing mal-adaptive practices and processes affecting parts of this protected area and its surrounded areas, and adopt a portfolio of ecosystem-based adaptation measures (from sustainable nature resource management to conservation and restoration) to enable people to overcome the alarming environmental crisis we are living today and reverse the effects that the growing trend of water scarcity and catastrophic events, like the last years harmful forest fires will have to our future generations.

Adaptive management and conservation of forests and forest species in the Mediterranean basin is a complex issue, given the wide range of ecological conditions, diverse forest uses and pressures exercised by different cultural groups and social interests.

Strategies for adaptive conservation

In many cases, adaptive management will require changes in silvicultural practices, as for instance adjusting rotation intervals and harvesting periods, or adopting innovative harvesting techniques. As an example, current charcoal production techniques of land clear cutting in *Ostrya carpinifolia* coppice forest stands in Jabal Moussa have an important environmental impact and do not accommodate well with the adaptation and mitigation objectives that this biosphere reserve should play. Alternative bio-energy production systems, (i.e. the production of wood pellets) based on coppice management, such as better adapted forest thinning techniques, may represent an economic alternative for local people and at the same time respond to important adaptation needs (reduce water competition between tree individuals under a climate change scenario of less precipitation; prevent stagnation of coppice forests and activate biomass production and more efficient carbon sink; etc).

Strategies for adaptive conservation should help maintain and enhance the function of the genetic system that secure the transfer of genetic diversity from one generation to the other and allows evolutionary responses to environmental changes. Mediterranean isolated relic or edge tree populations of forest species have survived significant changes in the climate since palaeo-times, representing important “genetic reserves” vis-à-vis the current climate change crisis. This may be the case of many forest ecosystems in Jabal Moussa, such as the very remarkable populations of *Juniperus drupacea*, *Quercus pseudocerris* and *Ostrya carpinifolia*. Research efforts should be promoted to better understand the role that reservoirs of forest diversity like Jabal Moussa can play in climate change adaptation and mitigation. Jabal Moussa Biosphere Reserve may become an observatory of the global change trends in the Middle East and cooperation should be strengthened with another existing regional observatory, the Sierra Nevada Biosphere Reserve in southern Spain, in the western part of the Mediterranean region.

Karst groundwater and caves are easily contaminated by rapid percolation of surface runoff into the aquifer, so man’s activities on the surface can have a devastating effect on the underground environment. The human impacts in the surrounding lands of Jabal Moussa Biosphere Reserve are very important, mainly derived from mining and quarrying, and building construction and related infrastructures (roads, sewer systems, aqueducts, waste dumps, etc.). Therefore, it is critically important to promote environmental impact assessments using multidisciplinary tools (biology, geomorphology, hydrology and social-economical sciences) to better understand the complex interaction between surface and groundwater ecosystems, and evaluate the present state and the effects of human disturbances causing the deterioration of the karst landscape in Jabal Moussa.

