

Steppes and grasslands in Morocco: Diversity, functional ecology and socio-economic role

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Abstract. With Morocco's geographical situation (at the crossroads between Europe and Africa, the Mediterranean Sea and the Atlantic Ocean), its diverse climate and habitats supports a varied natural vegetation. The floristic richness of the country is related to the heterogeneity of biotypes. From the desert to the high mountains and the littoral to the continental borders, Morocco offers varied ecological conditions that support many different plant species. Steppes and grasslands are important parts of the main plant associations encountered in Morocco. They contain a wealth of flora, play important ecological roles and, from a socioeconomic perspective, are highly significant.

Keywords: Steppes, grasslands, ecology, diversity, socioeconomic roles.

Introduction

Located in the extreme north-west of Africa, between 21° and 36° N latitude and 1° and 17° W longitude, Morocco covers an area of 710 850 km². Morocco's special geographic position between two coastlines provides a wide range of bioclimates ranging from humid and sub-humid to Saharan desert and through to the arid, semi-arid and high mountain climates in the Rif, Middle and High Atlas, where altitudes exceed 2500, 3000 and 4000m, respectively.

This climatic range creates a diverse ecosystem with many different natural environments: woody forests in pre-Saharan and Saharan steppe associations, degrading associations and grasslands with significant plant biodiversity compared to other Mediterranean countries with about 4200 plant species (4500 with sub-species) distributed among 940 genera and 135 families (Fennane, 1997).

The steppe associations in Morocco are an important part of plant biodiversity with a richness of aromatic, medicinal, pastoral and melliferous plants.

In this article, we give a brief description and information about some important plant associations covering mostly the high mountains and the arid and Saharan regions of Morocco.

Methodology

The methodology used is primarily based on bibliographical analysis of floristic and phytoecological work published during the last century. Old and recent data are compiled and interpreted to provide a description of the principal steppes and grasslands, emphasizing their plant species diversity, importance, ecology and role, as well as the principal factors responsible for their degradation.

Results

Steppe diversity

The arid and semi-arid steppes account for more than 68% of the total area of Morocco. They consist of ecosystems with a natural or semi-natural vegetation composed primarily of shrubs and grasslands. These steppes provide livelihood to thousands of people and they protect the country from rapid desertification. Despite the importance of these fragile areas, it is surprising that there has been no comprehensive assessment of their condition and evolution. However, available information on certain steppes shows that they are threatened by desertification because of a loss of plant biodiversity that also contributes to climate change. The main causes of degradation are humans and climate change. The steppe landscapes characterize regions where climatic conditions are severe. These include:

- the arid steppes of eastern and southern areas consisting essentially of alfa (*Stipa tenacissima*), Artemisia (*Artemisia herba-alba*), *Pistacia atlantica* and *Ziziphus slotus* and *Hammada scoparia* associations (Fig. 1).
- the semi-arid steppes of the high mountains supporting mainly spiny xerophytes such as *Alyssum spinosum*, *Erinacea anthyllis*, *Bupleurum spinosum*, *Vella mairei*, *Cytisus balansae*, *Astragalus boissieri* and *Astragalus ibrahimianus* (Fig. 2).

Besides their ecological role, the steppes play important economic and social roles. Indeed, they support pasture plants such as *Artemisia herba-alba*, *Bromus* spp., *Stipa tenacissima*, *Atriplex halimus*, *Thymus ciliatus*, *Dactylis glomerata*, *Paronychia argentea*, *Pistacia atlantica*, and *Moricandia arvensis*, aromatic and medicinal plants such as *Artemisia herba-alba*, *Thymus ciliatus*,



Figure 1. Arid steppe of *Stipa tenacissima*.



Figure 2. High mountain semi-arid steppe of spiny xerophytes.



Figure 3 Grasslands in High Eastern Atlas.



Figure 4 Grazing in High Eastern Atlas.

Capparis spinosa, and melliferous (honey) plants such as *Ziziphus lotus*, *Asparagus albus*, *Asparagus stipularis* and *Thymus ciliatus*. However, the steppes are favored by nomads and as a result have been over-grazed by their livestock causing profound changes in their structures and ecological functions, leading to the current situation of intense steppe degradation and sometimes fragmentation and dysfunction. Sustainable management and enhancement of the steppes will certainly benefit the development of the local people.

Functional ecology studies (Navarro *et al.* 2009, 2010) of thorny xerophytic species (*Vella mairei*, *Alyssum spinosum*, *Astragalus boissieri*, *Erinacea anthyllis*, *Arenaria pungens*, *Cytisus balansae*), at high altitudes (above 2500 m) and also *Acacia raddiana* on the Saharan steppe showed that severe weather (low temperatures at high altitudes and high temperatures in arid and Saharan steppes) are associated with adaptive mechanisms such as the production and dispersion of a large number of seeds.

Grasslands diversity

Grassland formations are common in Morocco especially in High Atlas and Middle Atlas areas (Fig. 3 and 4). They are herbaceous and based on hemicryptophytes, geophytes, mesophiles and hygrophile associations of important forage value (Ouhammou, 1996). Their existence is conditioned by water availability and they are constantly irrigated by water flow (Ionesco and Sauvage 1962).

These grasslands are floristically very rich, with many rare, threatened and/or endemic flora. They are characterized by species such as *Agropyrum festucoides*, *Poa alpina*, *Lolium perenne*, *Holcus lanatus*, *Ranunculus acris*, *Trifolium repens*, *Campanula mairei*, *Rorippa atlantica*, *Rumex pulcher*, *Eryngium variifolium* and *Aconitum lycoctonum*.

Various types of grasslands can be distinguished according to altitude. In the High Atlas, Ouhammou (1996) distinguished four grassland types:

- Grassland with *Lolium perenne*, *Holcus lanatus*, *Inula viscosa*, *Ranunculus acris*, and *Trifolium repens*; localized between 1 300 and 2 300 m.
- Grassland with *Festuca mairei*, *Aconitum lycoctonum* var. *rerayensis* and *Heracleum spondylium*; succeeds the first grassland type (above) and extends up to 3 000 m.
- Grassland with *Eryngium variifolium*, *Alchemilla arvensis* and *Rumex pulcher*, found in wet places.
- Grassland with *Cirsium chrysacanthum*, *Campanula mairei* and *Rorippa atlantica*; extends up to the high mountains.

Phytosociologically, grasslands of the high Moroccan mountains were studied by Quézel, (1957). Many associations support the *Caricetea curvilae* family, particularly that with *Trifolion humilis* alliance. They play an important role as livestock feed in summer and have a role in ecotourism by providing a green space in mountainous areas.

It is important to gain detailed knowledge of the functioning of the steppes to establish a valuation model and sustainable management for the development of the local people and biodiversity conservation.

Conclusion

Morocco has a diverse vegetation cover that is classified as forests, steppes or grasslands, distinguished by their unique floristic content and different ecological requirements. They are distributed mainly between thermomediterranean (minimum temperature between 3 and 7°C) and oromediterranean (minimum temperature is above 7°C) stages.

Some of the plant associations have been degraded by cutting, clearing and collection of wood, and overgrazing that leads to reduced plant density.

The Moroccan steppes and grasslands still require more research to help understand the need for an ecological approach to management and conservation.

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