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The world largest cork oak Maamora forest: challenges and the way ahead

Abstract

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A potential area of around 300.000 hectares of cork oak trees, that turned nowadays to a low density tree cover of less than 50.000 hectares, with a very disturbed or even absent climax environment. This is the case of the world largest cork oak Maamora forest located at the Moroccan Atlantic plain between Rabat and Kenitra cities.
Research programs and scientific articles related to this magnificent forest are various and dealt with all its aspects: ecologic, floristic, faunistic, socio-economic, cultural, etc.
The future of the Maamora forest, however, causes much concern despite the many initiatives and lots of efforts made to protect, conserve and rehabilitate its ecosystems. Both decision makers and managers failed to refrain this rapid regression and decline of this forest caused mostly by heavy and anarchic human pressure. The authors of this paper try to present an outcome of the situation and presume that nature by itself and through fencing might be the appropriate way to meet the challenge.
The current paper is a synthetic review of some of the work done about Maamora forest and the initiatives made to safeguard this green heritage.

Key words: *Quercus suber*, conservation, ecological equilibrium, N Africa.

Introduction

The Maamora forest plain is known to be the world largest cork oak stand that played and is still playing great ecological, socio-economic and political roles in Morocco. It has been subject to much research works, and its biological and ecological aspects are quiet well known.

The Maamora is particular with its history, some of its ecological aspects and contradictory dynamics of which the effects are negatively very heavy.

Its permanence has always been since the beginning of the last century of great concern to many Scientists and managers as well as for decision makers.

In this paper we are dealing with the essential characteristics of this unique ecosystem with a critical review to the human behaviour approaches in relation with its exploitation, management and protection. A call for a greater attention on the risks of impoverishment

of the biodiversity of this peculiar ecosistem has been presented by Rejdali & al. (2013) on the occasion of the XIV OPTIMA meeting held in Palermo in Semptember 2013.

Historical view

The occurrence of the cork oak on Moroccan Atlantic plain goes back to millions of years as shown by the pollen diagrams of three different sites: Oualidia, south west of El Jadida (Ballouche 1986), Mehdia, north east Rabat (Reille 1978), Krimda, north east Larache (Damblon 1991).

In Mehdia, the closer site to Maamora, *Quercus suber* L. pollen first appeared 6400 years b.p. (before present). This confirms Emberger's (1939) point of view who estimates that Maamora covers a potential area of around 300.000 hectares.

Concretely, the extent of the Maamora forest as delimited at the beginning of the last century was nearly 135.000 ha. Boudy (1958), author of this figure, talks about a stand of a fine growing and regularly rigorous enough forest without any alarming symptoms for the permanence. This status, generally satisfactory, is due to the insecure atmosphere that prevailed over centuries because of rivalries between tribes besides of its being a place of reference for rebels and looters. Even great sultans with their armed convey could not go through it. They always travel around the wood during their travels throughout the kingdom.

During the twentieth century to date, Maamora forest has played vital and great ecological, social and economic roles. Unfortunately, due to man abuse, the cork oak forest regressed quantitatively and qualitatively (status of population and individuals).

Nowadays, we witness a distressing landscape with large degraded areas (Fig.1). The forest, formerly uninhabited and dangerous for man, counts now around 300.000 residents

Fig. 1. General view of Maamora south est of Kenitra city (Google earth image 2015)

(Aafi 2007) and receives each week (except during rain periods) till 30.000 visitors and 5.000 cars: townsmen in search of relaxing and recreation spaces.

Main ecological and floristic aspects

Physical environment

The Maamora forest stretches over a vast low plateau (< 300 m of altitude) weakly rolling in its western part, and slightly furrowed in the eastern part. The soils are of varied thickness, almost everywhere sandy, laying on a more or less thick layer made up of stoneware clay or clayey sands locally rich in pisolites (reddish or blackish concretions of iron oxide and manganese). In depth, the geological substrate is shaped with Tortonian gray marl and clays of Miocene. It is worth mentioning, the presence of hydromorphic soils in dayas where cork oak is obviously absent as is the case of all other wood species.

From a climatic point of view, the Maamora receives an average of 300 to 500mm of rain fall per year spread over sixty days mainly of winter. Dry period covers at least five months (May to September) and meets high temperatures ; the average maximum in July and August is around 35° c.

Thus, we witness a semi-arid to sub-humid climate in west and north west. Occult precipitations (fog and dew) are common and important extra water for cork oak which takes benefit from the water table retained by the impermeable clay substrate.

Vegetation cover

We can simply say that the overall area of the Maamora plain is divided into four vegetation types of various importance: cork oak, scrub with wild olive and lentisc, coastal juniper forest and dayas vegetation.

Table 1. Areas covered by cork oak and other woody species (in hectares) in the Maamora.

	According to Naggar (2014), Figures of 2008	According to Aafi (2007)
Quercus suber	70 383	58 396
Eucalyptus sp. pl.	40 938	60 621
Acacia sp. pl.	2 523	
Pinus sp. pl.	9 442	5 686
others	8 472	
empty		7350
Total	131 758	132 053

In terms of surface, these natural areas are gradually and continuously losing space for the benefit of fully artificialised areas, wood plantation: eucalyptus, acacia, pin (Tab. 1); cereal , vegetable crops and fruit trees.

Cork Oak

It occupies nowadays the western part of the initial area. The more humid atmosphere and the sandy nature of the soil made here the ecosystem resilience more important than in the eastern part (drier and hard substrates) where the cork oak has completely disappeared.

The overall appearance is fairly homogeneous, dominated by two tree species: *Quercus suber* L. of highly varied density and a local endemic *Pyrus mamorensis* Trab. as isolated trees. The shrub element is typically rich in species *Teline linifolia* (L.) Webb & Berth., *Thymelaea lythroides* Barratte & Murb., *Phillyrea latifolia* L., *Halimium halimifolium* (L.) Willk., *Cistus salviifolius* L., *Lavandula stoechas* L., *Stauracanthus boivinii* (Webb) Samp., *Stauracanthus genistoides* (Brot.) Samp., *Daphne gnidium* L. and *Chamaerops humilis* L. which is becoming rarer and rarer. An important characteristic of the Cork oak of Maamora, that has negative influence on its natural renewal, is the palatabilty of its fruits, particularly sweet, that makes it demanded by animals and humans as food.

According to Aafi (2007), the dense cork oak forest (more than 200 trees/ha) covers only 4110 ha against 16 665 ha for the medium density (100-200 trees/ha) and 37 621 for open forest (less than 100 trees/ha).

Wild olive and Lentisc matorral

This vegetation type is spread in the oriental part, less humid on hard substrates. It has regressed a lot and anyway nowadays cork oak is completely absent. Matorral bunches of *Olea europaea* subsp. *oleaster* (Hoffm. & Link) Negodi, *Pistacia lensiscus* L., *Phillyrea latifolia* L., *Rhus pentaphylla* (Jacq.) Desf. etc. are current indicators.

Red coastal juniper wood land

This community occupies the coastal sand dunes where red juniper takes advantage and is more resistant to salt spray (salty sea water particles carried by the wind) and indifferent to the calcareous soil nature unlike cork oak. The Mehdia biological reserve gives a beautiful example of the juniper forest in good condition thanks to the protection provided by fencing for decades.

Dayas vegetation

Dayas are wet depressions more or less wide spread, with shallow temporary rainfall waters. These are asylvatic areas where grow low herbaceous species, floristically rich where flourish *Ranunculus aquatilis* L., *Panicum repens* L., *Illecebrum verticillatum* L., *Lemna gibba* L., *L. minor* L., *Eleocharis palustris* (L.) Roem. & Schult., *Isoetes* sp. pl., etc.

Flora

The Maamora counts many vascular species. More than the half are therophytes. According to Villemant & Titolet (1997), there are 750. Aafi (2007) noted that there are 408 specific and infra specific taxa, belonging to 261 genera and 62 families. We can still find 30 national endemic species and some peculiarities like *Maytenus senegalensis* (Lam.)

Exell and *Lotus benoistii* (Maire) Lassen (= *Benedictella benoistii* Maire), that are species with tropical affinities. Of peculiar interest for its relations with the cultivated species is *Cynara humilis* L.

The Maamora is rich with its cryptogamic flora which is not yet well studied and known regardless of some largely exploited species like truffle (*Terfezia* sp. pl.), lichen (*Parmelia* sp. pl. and *Cladonia* sp. pl.) and edible and poisonous mushrooms. Fungal biodiversity, by its own, counts 719 species according to Assfouri (2006) to whom this figure is too small below reality considering the many new data he could get in short time with little means.

Of interest, althought in severe regression, is also the bryophyte compound, in particular with some species of *Riccia*.

Alarming dynamic regression

The Maamora witnesses a very dramatic regression leading to the loss of hundreds of acres. An administration report (in Ghaioule & al. 2007) talks about an average loss of 1600 ha/year between 1955 and 2000. The causes of this disaster are divers and all in direct or indirect relation with man's behaviour.

Abusive exploitation of forest products

Timber and non-timber products extracted from the Maamora are numerous. However, apart from cork, the main regularly exploited product, the extraction of the other resources is done in anarchic and abusive ways as done to wood, charcoal, tannin, aromatic and medicinal plants, edible mushrooms thrashing and acorn harvesting (15000 tones per year according to Naggar 2014) etc.

Overgrazing (Tab. 2)

Overgrazing and the excessive acorns harvesting make it impossible for cork oak forest to regenerate naturally. Pastoral capacity is of 6,4 unit/year (UPB unites petit bétail) (Laaribya & al 2014). While the real optimum capacity balance is of 1.5 UPB. This means that capacity is four times higher than the ecosystem productivity.

Forest clearing and plantations

Forest clearing process is getting faster with human settlement. According to Aafi (2007) 300 settelments (douars) are set. Today, it is easy to see through Google Earth the extent of the cork oak surfaces that has been completely eliminated and replaced by houses, rangelands, cereal crops and vegetables and fruit trees.

Table 2. Evolution of the number of livestock in the Maamora.

	Boudy 1958 (figures 1955)	Laaribya & al. 2014
Ovins	104 800	173 000
Bovins	48 300	52 000
Total	153 100	225 000

Natural pests

The following fauna harmfull species are the most known: Gypsy Moth (*Limantria dispar*), lepidopteran defoliator; Great Capricorn (*Cerambix cerdo*), xylophagous beetle; Ant Cork (*Crematogaster scutellaris*), hymenoptera, burrows into cork; Cylindrical Platycarpe (*Platypus cylindrus*), xylophagous beetle; Gate-wood (*Cossus cossus*), lepidoptera, xylophagous.

There are also other species namely the xylophagous, but it should be noted that these devastating species are dangerous only for trees and stands in bad conditions as is well known in the world. Within the Maamora, many researchers and foresters have noted that in the royal reserve of Ain Johra, where the forest were in good condition, cork oak has never been devastated by the Gypsy moth.

Groundwater pumping

Water need for human use and agricultural activities is rapidly growing. The exploitation of the water table, being regular or not, becomes a current practice despite all its ecological dangers. This water table, the essential water supply to cork oak, is nowadays in danger. Fraval & Villemant (1997) noted "the water table of Maamora declines with an average of about 10 cm/year during the last 35 years."

Recreation area, peri-urban forest

The Maamora has been for decades a recreation and entertainment area for the inhabitants of the neighbouring cities (Rabat, Salé, Kenitra, Tiflet and Khemisset) even though the adequate accommodation for welcoming visitors without harm to the forest is not available (Fig. 2). The Maamora forest receives around 30 000 visitors and 5 000 cars per week.

Fig. 2. Wild pic-nic in the heart of Maamora forest.

Forest management and protection

The geographical situation and the socio-economical and political importance made the Maamora the first forest in Morocco to be managed by the Forest Department settled in the beginning of the last century. According to Piuyo (2012), the main efforts of French foresters, right from the beginning of the protectorate, were focused on the submission of the cork oak forest and its management to the state property since these woodlands were able to provide products highly needed by the French Metropolis.

Over the six last decades, Maamora was subject to three development plans (1951-71, 1972-92 and 1992-2012) of which the main aims are the exploitation, regeneration and protection of cork oak and artificial reforestation. The last project "Projet de rehabilitation de la Maamora" for the period 2005-2014 was with a global amount of 280 million dirhams (Naggar 2014) (about 25 million euros). A new management plan for the next decade (2015-2024) is being set.

Efforts of protection and conservation are shown by promoting natural regeneration by means of fencing which remains possible if the degradation is not too advanced.

The results of restocking by seeds or seedlings from nursery products are encouraging. Nevertheless, the appropriate areas concerned remain smaller than the one planted with exotic species namely *Eucalyptus* (formerly intended to supply Sidi Yahia plant pulp factory closed in 2012), *Pinus* and *Acacia* (Tab. 1)

Conclusion: What future for Maamora?

The status quo of the Maamora, of which we tried to present a precise and concise summary, is catastrophic. This forest is old, ecologically fragile and easy to reach. It has been victim of "its generosity" with the multiple services offered to man. Its disappearance seems to be ineluctable despite efforts and initiatives at its favour.

There is an infinite number of projects, programmes, meetings, credits, and expertise on it. The manager is helpless in front the dynamic process of regression. In spite of all this, there is yet a known solution. It consists of helping nature working by itself to repair damages. Everybody knows that natural regeneration is possible in the respected fences and that cork oak resists well to animal pests when the ecosystem is not fragile.

Why this solution has not been adopted ?

To our opinion, there are three answers :

1) The natural progressive dynamic needs time while the administration and the local want short time tangible results
2) The natural progressive dynamic needs decrease and halt of the anthropozone pressure. However, this complicated problem goes beyond providing vital needs for the Maamora inhabitants. It is used to satisfy the needs of citizens other than its inhabitants. For example half of the livestock belongs to citizens from the neighbouring cities.
3) Lack of courage and imagination. The issue is still dealt with traditional actions: projects, expertises, reports, seminars, and meetings. Tarrier & Delacre (2007) describe the situation in harsh terms "The Maamora lying near Rabat, its universities and administrations, the most amphigoric projects are wide emerging from either idealistic and respectable researchers in their wide naïvity, "we could be", or

project makers and sustainable management lobbyist "doers" who find in their desperate cases subsidies in foreign and innocent funding donors because, nowadays there are, by the side of the sick ecosystems of the whole world project makers and fairground showmen. It is one, amongst others, of the contemporary tartufferies and it works! At least for them."

Finally, it is worth to be reminded that a few centuries ago, our ancestors of the city of Salé complained the elephant of Maamora that spoiled gardens and crops. Our hope today is to avoid to see, tomorrow, our descendants struggling with moving sands coming from the same Maamora.

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