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BIODIVERSITY IN NORTH AFRICA: USES AND MANAGEMENT WITH SPECIAL REFERENCE TO MOROCCO

SUMMARY

The great diversity, in terms of ecosystems and floristic richness, of Northern African flora is shown; in particular, Morocco results to be one of the botanically most rich and diverse countries in the whole Mediterranean basin. The different threats, leading to the degradation of ecosystems and natural habitats and to the increasing of the number of rare and endangered species, are briefly illustrated. The necessary conservation measures, under way or planned, *in situ* and *ex situ*, are listed, stressing they are worthless if they are not supported with education.

RIASSUNTO

Biodiversità in Nord Africa: usi e gestione, con particolare riferimento al Marocco. Il Nord Africa presenta una grande diversità, in termini di ecosistemi e di ricchezza floristica; in particolare, il Marocco risulta essere uno dei paesi botanicamente più ricchi e diversi dell'intero bacino mediterraneo. Si illustrano quindi i principali fattori che conducono al degrado degli ecosistemi e degli habitat naturali e all'incremento del numero di specie rare e minacciate. Si indicano infine le necessarie misure di conservazione, già in corso o in progetto, *in situ* ed *ex situ*, evidenziando l'importanza fondamentale di programmi di educazione ambientale.

INTRODUCTION

Biodiversity is a fundamental support of life for all mankind and its animals. It serves as an important source of income for both poor and rich people. In fact, the livelihood of 1.3 billion people depends on it, 80% of the world's population rely on plant based traditional medicine.

The loss of biodiversity and habitat degradation is threatening the livelihood of more than one billion people living in dry and subhumid area. Within the Mediterranean region, North Africa, being the driest part of the area and probably the most dependent on biodiversity, deserves special attention in this regard and should be at the centre of environmental degradation and biodiversity conservation problems.

The aim of this paper is to review the Moroccan flora, to evaluate the problems to which it is exposed and to device means and techniques both *in situ* and *ex situ* to save this patrimony.

RICHNESS AND DIVERSITY OF THE MOROCCAN FLORA

Within Mediterranean region, North Africa is well known for its harbouring very remarkable plant diversity. Due to its strategic position at the confluence of the Atlantic Ocean, Mediterranean Sea, Saharan and European influences, and because of its extremely varied topography, Morocco is one of the botanically most rich and diverse countries in the whole Mediterranean basin. With over 7,000 plant species organized into 135 families and 940 genera (Tab. 1), it is taking the lead in North Africa and the Arab World (Tab. 2).

The qualitative assessment of the Maghreb flora proves that it is characterised by an extreme diversity as it shows Mediterranean elements, that make about 60% of the range of species such as *Olea europea,* also Macaronesian elements such as *Traganum moquini*, Saharo Sindian elements such as *Plantago major*; and finally, endemic species which account for over 20% in certain areas and which constitute the striking feature of the flora of this region. These endemics are distributed in 52 families and 230 genera.

Despite all of this, Morocco remains one of the least explored countries and the only country around the Mediterranean Sea without a single complete

Table 1
Richness of Moroccan flora

Plant Species	**Number**
Algae	400
Fungi	820
Lichens	700
Mosses	350
Ferns	60
Vascular plants	4,500 (species+subspecies)
TOTAL	7,000

Table 2
Morocco's Floristic position in the Mediterranean basin

Country	Estimated number of vascular plant species	Estimated number of endemic taxa
Egypt	2,100	—
Libya	1,800	134
Tunisia	2,200	14
Algeria	3,150	250
Morocco	**4,500**	**600-650**
Mauritania	1,100	—
Portugal	3,100	99-127
Spain	4,900	720
France	4,500	73
Italy	6,711	767
Corsica	2,500	31-170
Turkey	9,000	3,000
Lebanon	2,100	210
Syria	2,100	210
Jordan	2,500	—
Cyprus	1,760	134

Flora and thus its floristic study remains poor. The existing Floras are either regional or incomplete (e.g., VALDÉS *et al.*, 2002).

This green wealth is subject to hard pressure because of the various uses of plants by humans for their survival and well-being. For centuries, it has been customary to use plants as a major source for therapy and folk medicine. It is also common to use plants for timber, industrial purposes and as fuel wood and energy as well as utensils in daily life. This wide reliance on plants threatens their sustainability and necessitates special care and particular attention to make the best and harmless use of them.

THREATS AND DEGRADATION FACTORS

It is worth noting that the Maghreb, with an human population exceeding 80 millions, depends heavily on agriculture and livestock. Such dependence, combined with the irrational management of plant communities and species, has caused several degradation problems. Overgrazing in forests, *Stipa tenacissima* steppes and alpine vegetation has led to the vulnerability of many species some of which have become rare and threatened of extinction.

The flora is also exposed to a vast devastation of woodlands either for summer cereals, *Cannabis* cultivation or fuel wood which caused the destruction of

hundreds of hectares and led to the reduction of the former stands of many tree species (cf. REJDALI, 2004). It has been reported by the World Bank (1987) that Morocco was loosing 20 to 25,000 hectares per year, while recent estimates put the forest loss at over 30,000 ha/year. In Algeria, the forest loss was estimated at about 11,000 ha/year, while in Tunisia there has been a decrease of the forest territory from 1.25 Millions hectares in 1910 to 0.9 million hectares in 1986. A situation which, in our days, does not seem to know improvement. As for plant species, preliminary studies showed that, in Morocco, over one thousand plant species are either rare or threatened of extinction, while this number is around two hundreds for Algeria and over fifty for Tunisia.

As a matter of fact, these different threats (Figg. 1-9) lead to the degradation of ecosystems and natural habitats and to the increasing of the number of rare and endangered species. It is, also, to be noted that very little information is being provided about the threatened Moroccan plants and ecosystems.

Fig. 1 — Uncontrolled grazing in forests and alpine vegetation.

Fig. 2 — Poor soil vegetation management by most farmers and shepherds.

Fig. 3 — Fuel wood collecting, over exploitation of species.

Fig. 4

Fig. 5

Figg. 4, 5 — Widespread conversion of woodlands for summer cereals and other crops.

Fig. 6

Fig. 7

Figg. 6, 7 — Pollution from diverse sources.

CONSERVATION MEASURES AND MANAGEMENT

Whenever devising strategies for biodiversity conservations, it is worth asking: what should we be achieving in conservation? And how should it be better done?

It is commonly known that plant biodiversity conservation can be dealt with either *in situ* or *ex situ*. However, it should be stressed that the overall aim must be to have self sustaining wild populations (*in situ*) and *ex situ* conservation should be seen as a temporary «intensive care unit» for plants. No matter what we strive to achieve for conservation, sustainable living and environmental protection, must be to ensure that the loss of plant diversity is halted. This agenda needs to draw efforts together and have a global alliance of various botanical institutions, national and international government and non

Fig. 8

Fig. 9

Figg. 8, 9 — Forest reduction: 31,000 ha/year.

government organisations, botanic gardens and protected areas. These should have full support of the corporate and business sector, development aid agencies and many other bodies at all levels.

In situ conservation

Many efforts are being made in order to ensure the conservation of species in their natural habitat by creating protected areas, fenced zones, SBEI (Sites of Biological and Ecological Interests) or even, in the last years, using what is called ZIP (Zones of Interest for Plants).

In this context, there are eight parks and over 150 SBEIS that were defined through a national study on protected areas (Figg. 10-12). Only few of these are nowadays functional due to the lack of facilities and late promul-

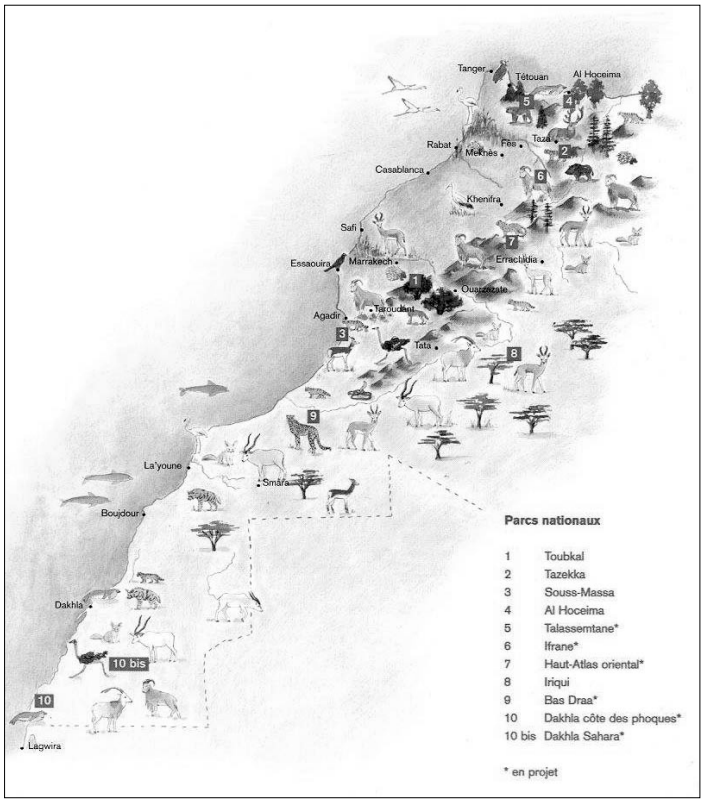

Fig. 10 — Conservation of species in their natural habitat, by creating Protected Areas or SBEIS (Sites of Biologic & Ecologic Interest). Six National Parks: >2,000,000 ha; 2 Natural Parks: >120,000 ha; 19 Biologic Reserves: >67,000 ha; 127 Natural Reserves: >1,000,000 ha.

Fig. 11 — *Abies maroccana* well conserved in Talassemtane National Park.

Fig. 12 — The Toubkal National Park is of great importance with its high level of endemism.

gated laws. It should be noted that some *in situ* conservation programs are concerning some particular cultivated land races in some regions of Morocco. An exemple of these is Alfalfa (*Medicago sativa*), a unique fodder crop grown in the desert valleys (Fig. 13).

Fig. 13 — Alfalfa (*Medicago sativa* L.) is the unique fodder crop grown in the desert valleys. The genetic diversity of its traditional cultivars is subject to an important *in situ* conservation programme in the Riche region (South-East).

Ex situ conservation

New concerns over environment and food safety encouraged worldwide movement and joined forces for more sustainable forms of conservation leading to a long lasting and sustainable development. Thus *ex situ* conservation through botanic gardens and arboreta plays a primary role through maintaining living plant collections (Figg. 14-17).

Fig. 14 — Botanic Garden of IAV (Institut Agronomique Vétérinaire).

Fig. 15 — Rare indigenous plant at IAV Botanic Garden.

Fig. 16 — Exotic Gardens of Bouknadel, Salé: plant collections and gardens laid out to evoke various regions in the world: China, South Asia, Savana, Congo, Japan, Brazil, Polynesia.

Fig. 17 — Jardin d'Essais, INRA, Rabat: an experimental garden aimed to the acclimatization of fruit trees, vegetables and ornamental species imported from around the world.

Another obvious way for botanic gardens and arboreta to be involved in *ex situ* conservation is through the maintenance of seed banks for long term conservation and the provision of education programs. It is worthy of remark that these are of little value if they are not taken with an integrated approach to conservation through partnership with associated organisation and public institutions.

It should be noted, however, that up to date *ex situ* conservation is limited to cultivated species and some of their wild relatives; and very seldom to forest trees or associated wild plant species. These species deserve special attention for their conservation before it is being late.

Conservation measures are worthless if they are not supported with education. Environmental education is of great importance. It should be done with relevant adapted structures and programmes. *In situ* and *ex situ* conservation measures cannot be effective without changing the human behaviour towards plant genetic resources (Fig. 18).

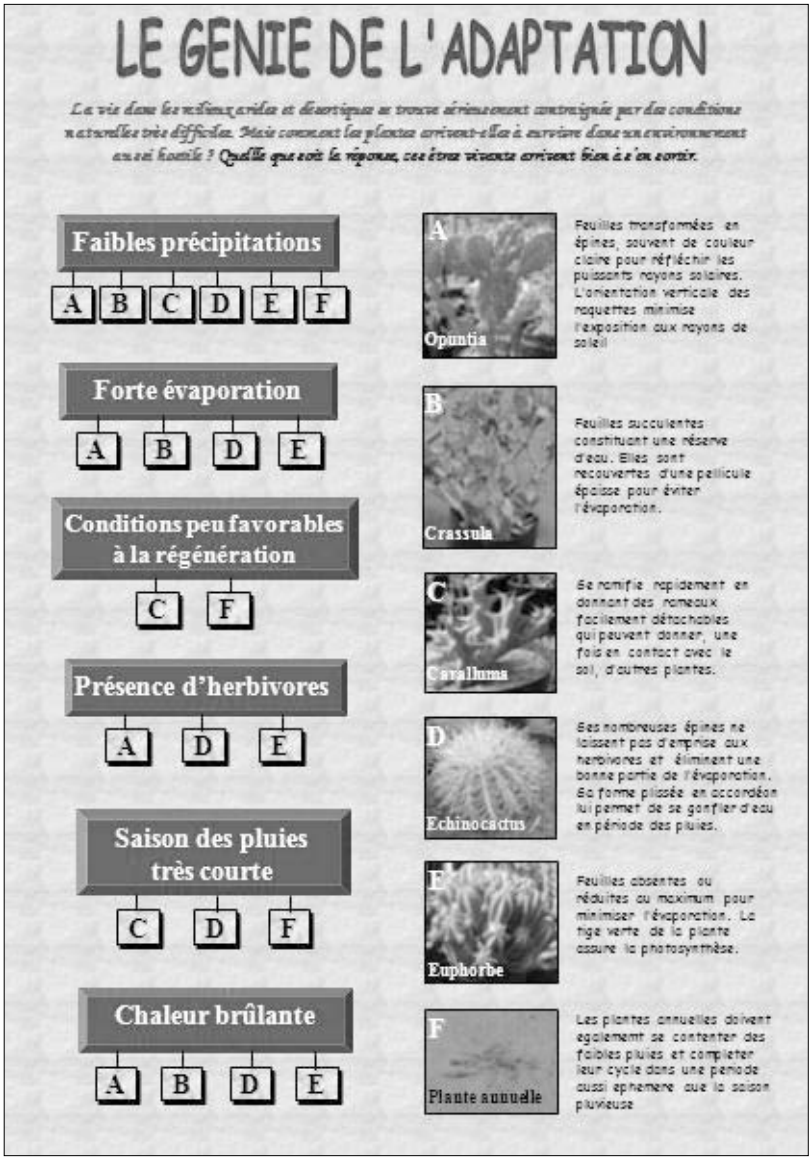

Fig. 18 a

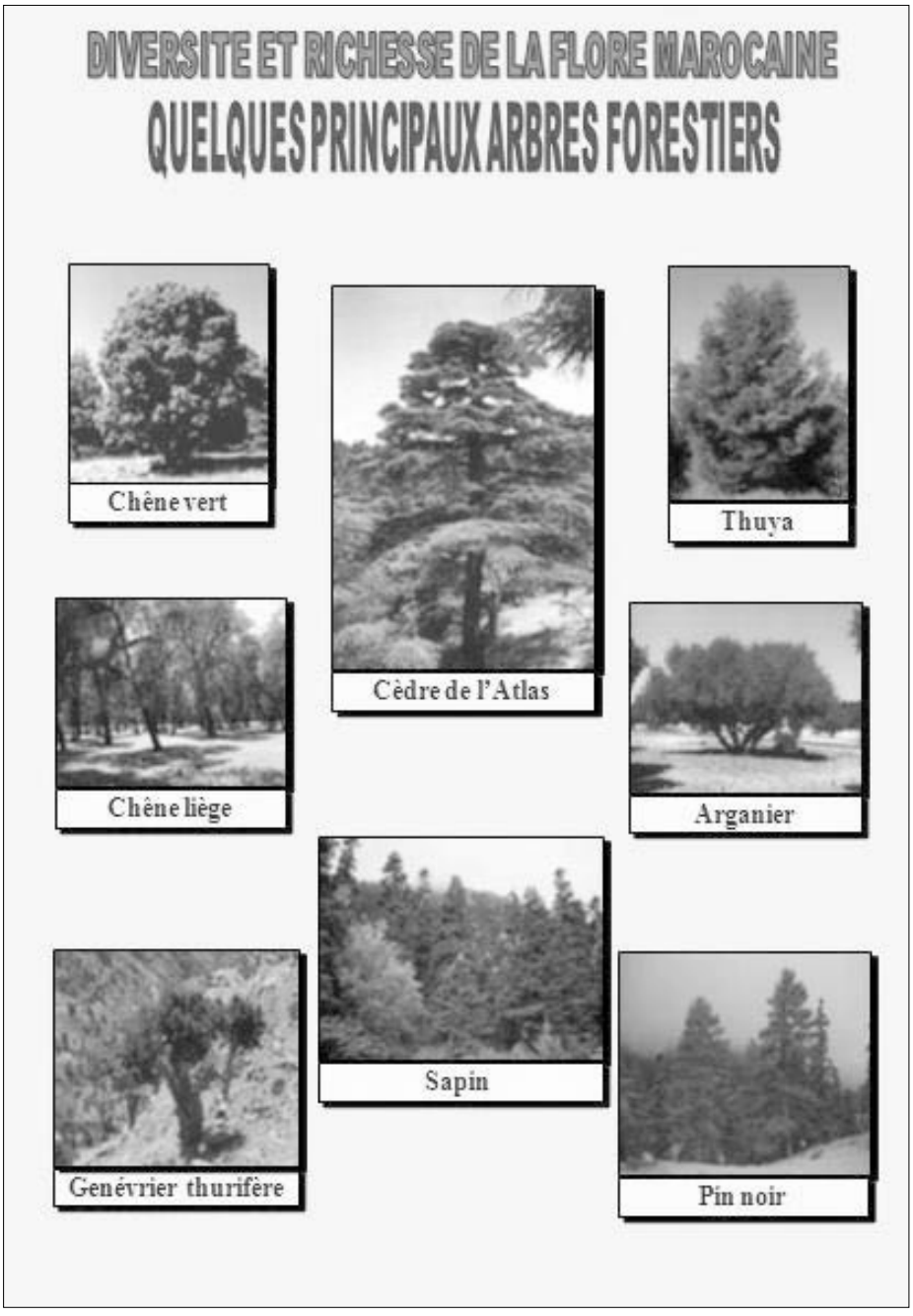
DIVERSITE ET RICHESSE DE LA FLORE MAROCAINE
QUELQUES PRINCIPAUX ARBRES FORESTIERS
Chêne vert
Cèdre de l'Atlas
Thuya
Chêne liège
Arganier
Sapin
Genévrier thurifère
Pin noir

Fig. 18 b

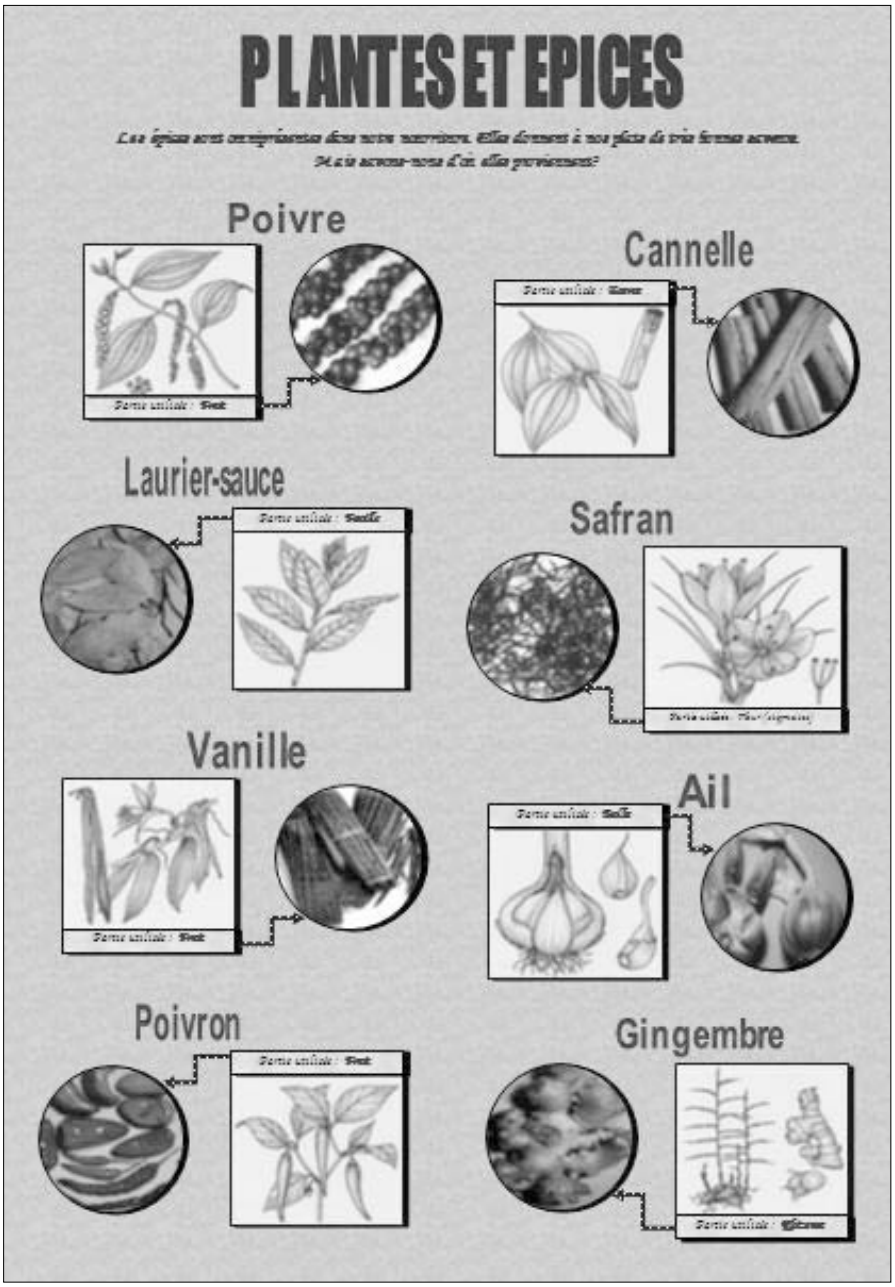

Fig. 18 c

Fig. 18 a,b,c — Examples of supporting educational material produced by the IAV Botanic Garden.

CONCLUSIONS

To conclude, it should be stressed that despite the floristic richness and diversity of North Africa, and Morocco in particular, the Flora is subject to a very hard pressure and faces many challenges.

Despite the efforts made and those under way, much remains to be done in order to save our biodiversity both *in situ* and *ex situ*. Besides, extra efforts are to be made to overcome the different problems facing our biodiversity. It should also be noted that the development of environmental education programs are badly needed to raise public awareness about the importance of biodiversity and the necessity of its conservation.

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