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Research article

ECOLOGICAL AND MEDICINAL INTEREST OF TAZA NATIONAL PARK FLORA (JIJEL - ALGERIA)

BOUNAR Rabah[1,2]*, REBBAS Khellaf[2], GHARZOULI Rachid[1], DJELLOULI Yamna[3]and ABBAD Abdelaziz[4]

[1] *Department of Biological Sciences, University of Ferhat Abbas Setif 19000, Algeria.*
[2] *Department of Nature and Life Sciences, University of M'Sila 28000, Algeria.*
[3] *Department of Geography, University of Maine, 72085 Le Mans, France.*
[4] *Faculty of Sciences, University Cadi Ayyad, Semlalia, BP 2390, Marrakech, Morocco.*

**Corresponding Author: E-mail: br_s_dz@yahoo.fr*

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ABSTRACT

The forest of Taza National Park (NP), located in North-Eastern Algeria, is characterized by a high floristic diversity. Analysis of the park flora showed 420 species belonging to 258 genera and 71 botanical families. *Asteraceae* (54 species), *Fabaceae* (37), *Poaceae* (34), *Lamiaceae* (26) and *Brassicaceae* (24) are the most dominant families. The endemism rate is around 12.38% (52 species); approximately 21% of endemic species of Algeria. Rare and very rare species were estimated to be 120 taxa representing 28.57% compared to the park flora. Analysis of global phytochoric spectrum shows dominance of native Mediterranean species (193 species). This floristic wealth contains a number of 205 species of medicinal interest.

KEYWORDS: Floristic diversity, medicinal plants, Taza National Park, Algeria.

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INTRODUCTION

Algeria, like all Mediterranean countries, has long been involved in the politics of preservation and conservation of biodiversity through the creation of several National Park's. Currently, it counts eight NP's including all original landscapes the main hot spots of plant biodiversity in the country (Benhouhou & Vela, 2007). Several research works mainly focused on the identification and mapping of the phyto-biodiversity have been made in these hot spots: NP of Chrea (Zeraia, 1981), NP of El Kala (Stevenson *et al.*, 1988; Belouahem *et al.*, 2009), NP of Tlemcen (Yahi *et al.*, 2007; Letreuch-Belarouci *et al.*, 2009) and NP of Gouraya (Rebbas, 2002; Rebbas *et al.*, 2011).

These research works underlined the rich flora of these areas and highlighted panoply of endemic and/or rare species which must be placed in conservation priorities. This work also evoked the advanced state of degradation of these natural ecosystems and emphasized the importance of such an inventory list in the rational management of these natural ecosystems. Indeed, several authors evoked that the conservation and the development of a natural ecosystem pass by a good knowledge of its biodiversity (Daget & Poissonnet, 1971; Médail & Quezel, 1997; Véla & Benhouhou, 2007).

In order to know the vascular flora of these natural environments, we are interested by the study the floristic diversity of one of the most original ecosystems, at a biogeographic and ecological level, of the Algerian North-eastern sector. It is about Taza NP which belongs to the small Kabylia sector of the Babors (Figure 1) and is regarded as the most wooden area in Algeria with a very high rate (Bensettiti & Abdelkrim, 1990).

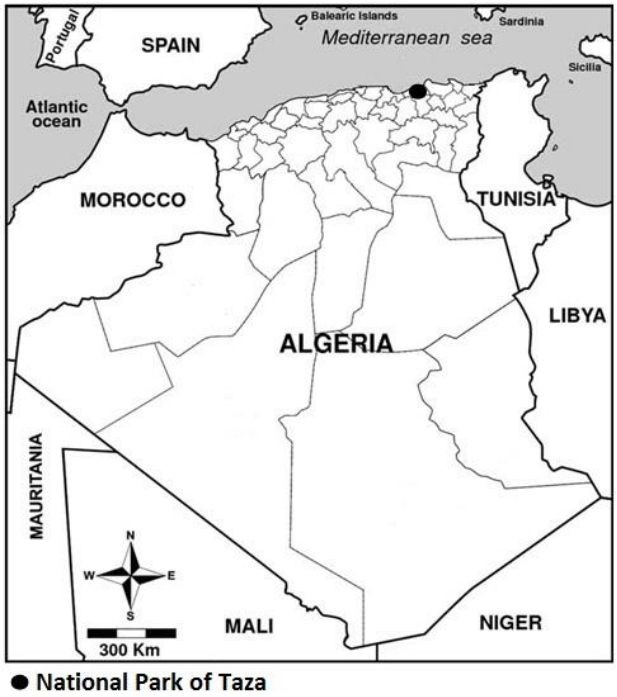
This work fills the gaps on the state of current knowledge on the vascular flora of the Taza National Park. Indeed, the only known floristic inventory work known in the area and concerned neighborhoods of the Park primarily (Gharzouli 1989; Gharzouli & Djellouli, 2005 Gharzouli, 2007, Bounar, 2003). Only work of floristic synthesis which refers to all North Eastern Algeria remains very old and not updated (Khelifi 1987; Aouedi 1989; Aktouche *et al.*, 1991). Other research made on some forest formations of the park remains very sketchy. As examples, we can mention phytosociological work of Zeraia (1981), Dahmani (1984) and Bensettiti & Abdelkrim (1990). Knowledge of the diversity of species of medicinal interest of this area allows us to offer solutions for conservation and recovery of these resources within the framework of sustainable development.

I- Presentation of the study area

Taza NP was created in 1984 on a total area of 3807 ha. It is located in the North-East of Algeria between geographical coordinates 36° 35'–36° 48' North latitude and 5° 29'–5° 40' West longitude. Taking part of the small Kabylia of Babors, it opens onto the Mediterranean Sea in the Gulf of Bejaia (Figure 1). According to the rainfall map established by the National Agency for Water Resources (NAWR, 1996), the study area is situated in annual sections ranging from 850 mm–1750 mm. Average minimum temperature of the coldest month (January) varies between 6.1° C and 8.1° C. Maximum temperatures of the hottest month (July) is between 30.2° C and 34.8° C. Dry period varies from 3–5 months. High relative humidity of the air (80%) promotes the installation and maintenance of quite important plant diversity. Emberger pluviothermic quotient Q_2 (Emberger, 1955) varies between 110 and 124 placing the Park in humid bioclimatic stages to sub-humid with variations to mild and warm winter (Daget & David, 1982).

The Park presents a very rugged terrain including several mountain ranges oriented from east to west with altitude varying from 480 m to the highest point in the area (1121 m). These orographic elements give a general configuration in folds in North-eastern and South-western orientations. Geologically, the area is dominated by sedimentary grounds of sandstone and volcanic soils in North zones (Obert, 1970).

Figure 1 Localization map of the study area (Amrani *et al.*, 2010)



These climatic and lithological characteristics determine a rich and diversified flora whose principal forest species are the zeen oak (*Quercus canariensis* Willd) , which covers more than 40%, the cork oak (*Quercus suber* L) with 39% and afares oak (*Quercus afares* Pomel) with only 5% (Bensettiti & Abdelkrim, 1990). According to Maire (1926), Quezel & Santa (1962-1963), Zeraia (1983), Barry *et al.* (1974), Quezel (1978) and Barbero *et al.* (2001), Taza NP is on the phyto-geographical region Mediterranean, North African Mediterranean area and belonging to the Numidian.

II - METHODOLOGY

Park flora was established by floristic surveys carried out, according to the phytosociological method, in different types of vegetation. Surfaces floristically homogeneous were defined on the basis of most common ecological parameters such as altitude, exposure and slope. Covering of the vegetation, by layer, was also taken into account. 63 floristic surveys were carried out. Survey surface varies according to vegetation types. It oscillates between 300–400 m² for forest vegetation and between 5 and 10 m² for rupicolous vegetation. Surveys were conducted during years 2005 and 2008.

The floristic surveys were carried out according to a subjective sampling in all vegetation types of the Park. Samples of plant species collected were determined in laboratory using different flora: Maire (1952-1987), Quezel & Santa (1962-1963), Fennane *et al.* (1999; 2007) and Valdes *et al.* (2002). Species nomenclature adopted was according to "Med-Cheklist, critical inventory of vascular plants of circum Mediterranean countries"(Greuter *et al.*, 1984).

Control samples of collected species were deposited in the laboratory of Setif University. Chorologic types of various identified taxa were assigned as indicated in consulted floras; special attention was given to endemic and/or rare species. Analysis of the floral study area and various ethnobotanical fieldwork in the Park surrounding regions, allowed us to have an extensive list of medicinal plants used by the neighboring population.

III-RESULTS AND DISCUSSION

Specific richness

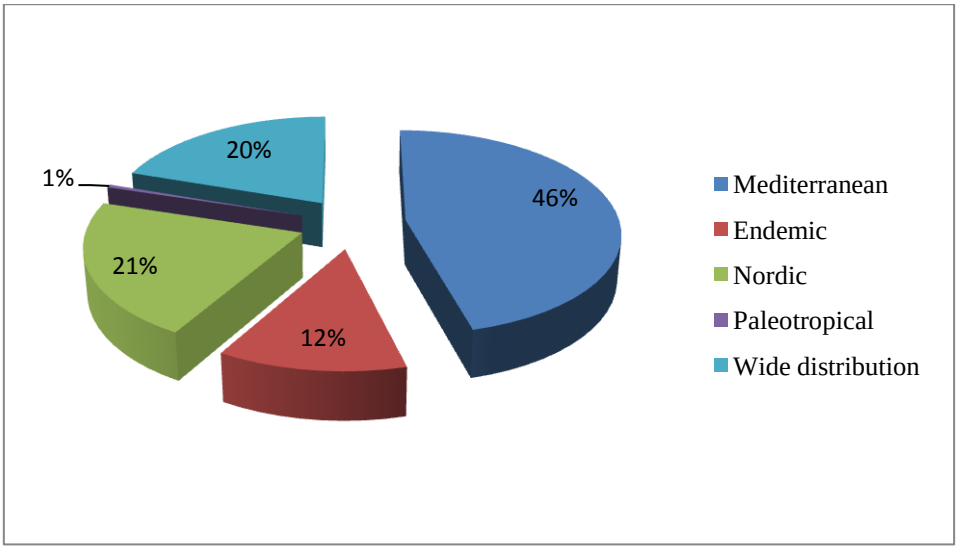
Enumerated taxa were 420 species and subspecies belonging to 258 genera and 71 botanical families of vascular plants (phanerogams and vascular cryptogams); approximately 10% of the Algerian total flora estimated at 3139 species (Quezel & Santa, 1962; 1963). Phanerophytes (41 species) occupy 9% of the Park flora. On the total flora recorded at the Park, *Asteraceae*, *Fabaceae*, *Poaceae*, *Lamiaceae*, *Brassicaceae*, *Caryophyllaceae* and *Rosaceae* were best represented with more than 20 species each. These families represent nearly 40% of the total richness of the Park.

Our results are consistent with those of Gharzouli & Djellouli (2005). This wealth places the Park among the most diversified ecosystems in the country, as is the case for all Small Kabylia (Gharzouli, 2007; Vela & Benhouhou, 2007). This floristic wealth of the Park is probably due to (i) its geographical position opening directly on the Mediterranean Sea and therefore exposed to the maritime influences of the North-West (ii) diversity of habitats resulting from climatic and edaphic heterogeneity and (iii) a relatively weaker exploitation of the medium compared to other ecosystems.

Chorological Type

Floristic analysis shows the presence of several phytochoric units (Figure 2). Mediterranean one is the most representative with 193 species. This situation is common to most natural ecosystems of Algeria (Quezel, 1964; 2002) and the Mediterranean basin (Dahmani, 1984; Quezel & Barbero, 1990; Quezel & Medail, 2003). This whole Mediterranean is divided into several subsets: *s.l.* Mediterranean (114 species), western Mediterranean (42 species), Ibero-mediterranean (20 species), oro-mediterranean (8 species), central mediterranean (2 species) and eastern mediterranean (7 species). Northern chorologic species (Nordic) are relatively well represented in the Park, such as those of european element (20 species), eurasian (41 species), paleo-tempered (22 species), circum-boreal (6 species), oro-european (01 species) and atlantic (14 species). Other species correspond to transition elements between chorological mediterranean and those neighbors such as the euro-Mediterranean (30 species), mediterranean-irano-turanian (6 species), macaronesian, mediterranean and asian mediterranean with 4 species each.

Figure 2 Chorological spectrum of Taza National Park



Analysis of endemism

52 taxa were recorded, about 12.38% of total species of the Park and 9.47% compared to the total endemic flora of the country estimated at 549 species (Quezel, 1964) and nearly 12.7% of northern Algeria (Vela & Benhouhou, 2007). Endemism rate is relatively high compared to that recorded in several Parks in central and eastern Algeria such that of Belezma -Batna- (32 species), Gouraya -Bejaia- (26 species) (Rebbas, 2002; Rebbas *et al.*, 2011), Djurdjura (35 species) (Meribai, 2006) and Kala -Taref- (75 species) (Stevenson, 1988).

Endemic flora of Taza Park consists mainly of endemic Algerian species (18 species), North Africa (22 species), Algerian-Moroccan (5 species), Algerian-Tunisian (7 species). 13.47% of the Park endemic taxa belonged to *Asteraceae* and *Lamiaceae* families with 7 species each.

Analysis of the rarity

Relying on Quezel & Santa data (1962; 1963) nearly 120 species were reported as rare or very rare. On the basis of these data, the Taza NP records a 28% rarity rate of all its inventoried taxa and around 7% compared to rare species of northern Algeria and about 6.6% over the entire national territory. Compared to the phyto-geographical of Kabylia totaling approximately 487 rare species (Vela & Benhouhou, 2007), Taza NP occupies nearly 24.6% (Figure 3).

Among the 129 Algerian taxa Red listed by the International Union for Nature Conservation (1980), 12 species belong to the Taza NP spread over the studied three types of formations (Tables 1 and 2).

Figure 3: Rare Plants in Taza National Park (Photos: K. Rebbas, 2011)

1. *Phlomis bovei* de Noé
2. *Berberis hispanica* Boiss. et Reut.,
3. *Atropa belladonna* L.
4. *Crataegus laciniata* Ucria.

Table 1 : Number of rare and endemic species per botanical family

Botanical families	Number of endemic species	Percentage (%)	Number of rare species	Percentage (%)
Asteraceae	07	13.46	16	13.33
Lamiaceae	07	13.46	07	5.83
Poaceae	03	5.76	11	9.16
Caryophyllaceae	03	5.76	09	7.5
Brassicaceae	03	5.76	12	10
Fabaceae	03	5.76	13	10.83
Scrofulariaceae	03	5.76	04	3.33
Apiaceae	03	5.76	08	6.66
Ranunculaceae	02	3.84	05	4.16
Crassulaceae	02	3.84	03	2.5
Campanulaceae	02	3.84	01	0.83
Pinaceae	01	1.92	01	0.83
Fagaceae	01	1.92	-	-
Berberidaceae	01	1.92	02	1.66
Geraniaceae	01	1.92	02	1.66
Thymelaeaecea	01	1.92	02	1.66
Violaceae	01	1.92	01	0.83
Cistaceae	01	1.92	-	-
Primulaceae	01	1.92	01	0.83
Convolvulaceae	01	1.92	02	1.66
Plantaginaceae	01	1.92	-	-
Rubiaceae	01	1.92	04	3.33
Caprifoliaceae	01	1.92	04	3.33
Valerianaceae	01	1.92	02	1.66
Linaceae	01	1.92	-	-
Rosaceae	-	-	07	5.83
Saxifragaceae	-	-	03	2.59
Total	52		120	100

Medicinal plants

205 species of medicinal interest were enumerated. Development of research in field of pharmacology and identification of species active principles will create economic activity in use of plants organized in a friendly safeguard flora.

As in the majority of Algerian areas, some of these species are employed by inhabitants bordering the Park as traditional medicine and are marketed by herbalists (*Alnus glutinosa* L., *Arbutus unedo* L., *Asphodelus microcarpus* Salzm. & Viv., *Asparagus officinalis* L., *Clematis flammula* L., *Ceterach officinarum* Lamk, *Crataegus laevigata* (Poiret) DC, *Crataegus laciniata* Ucria, *Mentha pulegium* L., *Mentha spicata* L., *Inula viscosa* L., *Mentha rotundifolia* L., *Myrtus communis* L., *Opuntia ficus indica* (L.) Mill., *Ficus carica* L., *Pistacia lentiscus* L., *Prunus avium* L., *Punica granatum* L., *Quercus suber* L., *Juniperus oxycedrus* L., *Nerium oleander* L., *Teucrium polium* L., *Thapsia garganica* L., *Ulmus campestris* L).

Table 2: Rate rarity by chorological origin

Chorological origin	Total number of species	Percentage rate (%)	Degree of rarity	
			Total species rare and very rare	Percentage rate (%)
Mediterraneans	193	45.95	73	37.82
Mediterranean	114			
Western Mediterranean	42			
Ibero-Mauritanian	20			
Euro-Mediterranean	08			
Central Mediterranean	02			
East Mediterranean	07			
endemics	52	12.38	11	21.15
Algerian endemic	18			
North African	22			
Algerian-Moroccan	05			
Algerian-Tunisian	07			
Nordics	90	21.42	19	21.11
Eurasiatic	41			
European	20			
Paleo-Temperate	22			
Circum-Boreal	06			
Oro-European	01			
paleotropicals	02	0.47	1	50
Wide distribution	83	19.78	16	19.27
Euro-Mediterranean	30			
Atlantic-Mediterranean	14			
Macaronesian-Mediterranean	04			
Eurasiatic-Mediterranean	02			
Asiatic-Mediterranean	04			
Irano-Turanian-Mediterranean	06			
Eurasian-Macaronesian	03			
Mediterraneo-Saharan-Arabian	02			
diverse	18			
Total	420	100	120	

Many plants were subject (of) to phytochemical analysis and ethnobotanical studies in North Africa in general and in Algeria in particular. Majority of these plants appear in the floristic list of the study area like: *Berberis hispanica* Boiss. & Reut., *Bupleurum montanum* Coss, *Cynodon dactylon* L., *Inula crithmoides* L., *Inula viscosa* L., *Origanum glandulosum* Desf., *Olea europaea* L., *Pistacia lentiscus* L., *Phlomis bovei* de Noé, *Salvia verbenaca* L., *Teucrium polium* L. *Ricinus communis* L (Chemli, 1997; Hmamouchi, 1997; Baba Aissa, 1999; Ruberto *et al.*, 2002;

Belarchaoui & Boukhadra, 2006; Boulaacheb, 2006; Sari *et al.*, 2006; Hseini & Kahouadji, 2007; Liolios *et al.*, 2007; Benguerba, 2008; Laouer *et al.*, 2009; Hachicha *et al.*, 2009 ; Derridj *et al.*, 2009; Ouled Dhaou *et al.*, 2010; Cahuzac-Picaud, 2010; Makhlouf *et al.*, 2010; El Youbi, 2011; Rebbas *et al.*, 2012; Lemoui *et al.*, 2012; Sari *et al.*, 2012; Hendel *et al.*, 2012).

The anarchy in exploitation of the species known for their therapeutic virtues constitutes a risk for their survival. Certain species are in danger of extinction because of their overexploitation (abusive pulling up). It is the case of Lamiaceae species which are uprooted (torn off with their roots), to be sold in towns and villages of the area, as: *Teucrium polium* L., *Mentha rotundiflolia* L., *Origanum glandulosum* Desf

CONCLUSION

Analysis of the floristic diversity of Taza NP shows well its great richness and its ecological and phytogenetic originality. These data justify its classification with all small Kabylia as a hot spot in northern Algeria (Vela & Benhouhou, 2007). Despite legislative protection, this Park, like most Mediterranean natural ecosystems, is subject to a worrying degradation. Indeed, human activities (anarchic collection of wood, cork exploitation, uprooting plants of interest) and uncontrolled pasture are seriously detrimental to the richness. To face these problems and to keep the ecological integrity of the Park, an integrated strategy for conservation of biodiversity must be installed.

This strategy must be focused primarily on tree forestation of the Park, especially with zeen oak (*Quercus canariensis* Willd), cork oak (*Quecus suber* L) and afares oak (*Quercus afares* Pomel) which constitute the essential structure of this natural ecosystem. These principal forest formations harbor several endemic and/or rare genera like Cyclamen, Corydalis. Many rare or endangered species of the Park deserve to be integrated in the Red List of the International Union for Conservation of Nature (IUCN). It is about *Galium odoratum* (L) Scop, S*atureja juliana* L., *Viburnum lantana* L., *Hieracium ernest* Maire, *Convolvulus dryadum* Maire, *Stellaria holostea* L, *Chrysanthemum fontanesii* L., *Bupleurum montanum* Coss, *Quercus afares* Pomel and *Sedum pubescens* Vahl. (Table 3).

Table 3 : Rare and endangered species in Taza National Park.

Species not listed in the IUCN Red List	Species listed in the IUCN Red List
***Galium odoratum* (L) Scop**	*Arabis doumetii* Coss.
***Satureja juliana* L.**	*Saxifraga numidica* Maire
***Hieracium ernest* Maire**	*Teucrium kabylicum* Batt.
***Viburnum lantana* L.**	*Fedia sulcata* Pomel.
***Convolvulus dryadum* Maire**	*Carum montanum* (Coss & Dur.)Benth.
***Stellaria holostea* L.**	*Lonicera kabylica* Rehder.
***Chrysanthemum fontanesii* L.**	*Teucrium atratum* Pomel.
***Bupleurum montanum* Coss.**	*Epimedium perralderianum* Coss.
***Quercus afares*Pomel**	*Phlomis bovei* de Noé.
***Sedum pubescens* Vahl.**	*Sedum multiceps* Coss & Durieu.
	Pimpinella battandieri Chabert
	Moehringia stellaroides Coss.

IUCN :International Union for Conservation of Nature

Increasing ethno botanical studies will allow a better potential understanding of this field, evaluate consequent risks to the use of certain toxic plants and adopt a new management approach for protection and preservation of natural resources (Lahsissene *et al.*, 2010). A large number of spontaneous species of the study area are used in medicine and food like fodder. Culture of these species for economic interest, instead of anarchic gathering, can improve the income of local people while ensuring the conservation of plant diversity (Bounar *et al.*, 2012).

For the extraction of active ingredients, the creation of plots of medicinal plants selected, from lists established by floristic inventories, can replace the one gathered. In Algeria, the market for plants with medicinal properties is uncontrolled (Boulaacheb *et al.*, 2006). Considering the various uses of these plants, a regulation seems necessary. So every country must define its own specifications (Veuillot, 2001).

Rare and endemic species of the study area form a draft list of local red rare and endangered flora. The protection and conservation of these formations are needed more than ever before and should receive strict protection. Tourism activities and grazing may be detrimental to the biodiversity of the Park. Urgent solutions must be found to ensure their survival.

South of the Mediterranean, where the situation is much more serious, accomplishments are sporadic and generally ineffective. Only authoritative decisions taken by national leaders would likely aim at preserving some ecosystems or certain groups particularly at risk. It is this desire that has been taken in Rabat in 1987, at the meeting for the conservation of plant resources in the countries of North Africa (Quezel et Barbero, 1990).

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