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DEMARCATIION AND PROTECTION OF *Pistacia atlantica* Desf. IN SETIFIAN STEPPE (NORTH- EAST OF ALGERIA)

L. S.CHERMAT^{1*}, R.BOUNAR²

¹ University Ferhat Abbas Setif-1. Laboratory Project Urban City and Territory (LPUVIT).

² University Mohamed Boudiaf M' sila Algeria

*Corresponding author: s.chermat@univ-setif.dz

Abstract: Rare endemic and threatened with extinction, *Pistacia atlantica* Desf. is one of the heritage species of Algeria, it occupies a very important place from an ecological and socio-economic point of view. The Atlas pistachio tree is distinguished by very high resistance and known for its high plasticity and its adaptation to arid and semi - arid climates. In the region of Sétif *Pistacia atlantica* Desf. exists only in the semi-arid Setifian steppe, in djebel Boutaleb, djebel Youssef and djebel Zdim. Faced with its vulnerability, this species confined to a very restricted area, requires protection and sustainability of its development to ensure its sustainability within the Sétif region.

Keywords: *Pistacia atlantica* Desf, Endemism, Vulnerability, Valuation, Sustainability, Sétif.

1. Introduction

Having a very limited distribution area in Algeria, the Atlas pistachio tree (*Pistacia atlantica* Desf.) is an endemic species, present in semi-arid, arid and even Saharan regions. According to Ramade [1], endemism is a phenomenon by which a species or a taxonomic group is strictly subservient to a given biogeographical area, generally of limited surface, in which it has differentiated due to the existence of special ecological conditions specific to the area. The most characteristic of the Atlas of Algeria, this species constitutes very important populations both ecologically and biogeographically and with its inescapable interests and its multiple uses, continues to decline from year to year following climate impacts and especially anthropogenic.

It is important to note that in Algeria the Atlas pistachio tree is one of the unknown resources on the ecological and floristic level, there is no specific and exhaustive national inventory on the stands of *Pistacia atlantica* Desf. and their distribution areas. Most of the work carried out on this species has focused on histomorphological studies [2, 3, 4, 5, 6, 7]. Very rare are the phytoecological studies carried out in western Algeria and in the Sahara [8, 9]. We note that no study has been carried out on the phytoecology of the Atlas pistachio tree in eastern Algeria.

The Atlas pistachio tree generally develops in a sparse and isolated form, it is known among the species which have a resistance to natural phenomena in steppe and arid areas, subject to edapho-climatic constraints on the one hand and anthropogenic on the other hand, it supports strong winds and long periods of drought amplified by increasing pressure from man and his herds.

This ecological plasticity gives it a very important place from the point of view of floristic study and delimitation of its stands in interaction with their habitats, the aim of which is their protection and sustainable development. Currently we are witnessing an overexploitation of *Pistacia atlantica* Desf products in the steppe region of the Hautes Plains Sétifiennes.

The growing problem facing the region is the gradual disappearance of this species, a non-renewable resource, reported as rare endemic to protect [10].

Thus our objectives aim at a better knowledge on the populations of *Pistacia atlantica* and on their areas of distribution by fighting against the factors of degradation due to the abusive anthropic activities.

This is necessary to better manage the threats which weigh on this species and to establish an adequate management plan to support its balanced and sustainable development in the Sétif region.

2. Materials and methods

2.1. Studied area

Located in the southern part of the wilaya of Sétif, this sector includes several djebels including djebel Youssef, djebel Zdimm and djebel Boutaleb which constitute the southern limit (fig.1), beyond, towards the south is the depression of Hodna, which constitutes a Saharan enclave within the high steppe plains. These three massifs are located in the southern part of the high Plains of Setif, where the steppe influence is quite marked [10].

Djebel Youssef stretches from east to west over ten km between coordinates $36^{\circ} 01'21.5''$ North and $5^{\circ} 24'50.7''$ East. It rises to 1442 m with foothills around 910 m altitude.

Djebel Zdimm is located about twenty km west of djebel Youssef between $36^{\circ} 01'30.5''$ North

and $5^{\circ} 10'06.6''$ East. It rises to an altitude of 1258 m and foothills of 900 m.

These two steep massifs with their steep slopes are in contact with two structural groups, the platform of the Setifian tell to the north and the salt depressions (chotts and sebkha) to the south.

Djebel Boutaleb constitutes an important and well individualized link in the eastern part of the chain of the Hodna mountains between the geographical coordinates of $35^{\circ} 41'14.7''$ North and $5^{\circ} 15'50.4''$ East. It is located between the high Sétifian plains to the north and the Hodna basin to the south .

Djebel Boutaleb has relatively high altitudes, varying between 980 m and 1886 m.

The south of Setif, has essentially limestone soils with most often hard limestone accumulations near the surface [11]. These soils generally have a thin, skeletal surface horizon poor in organic matter.

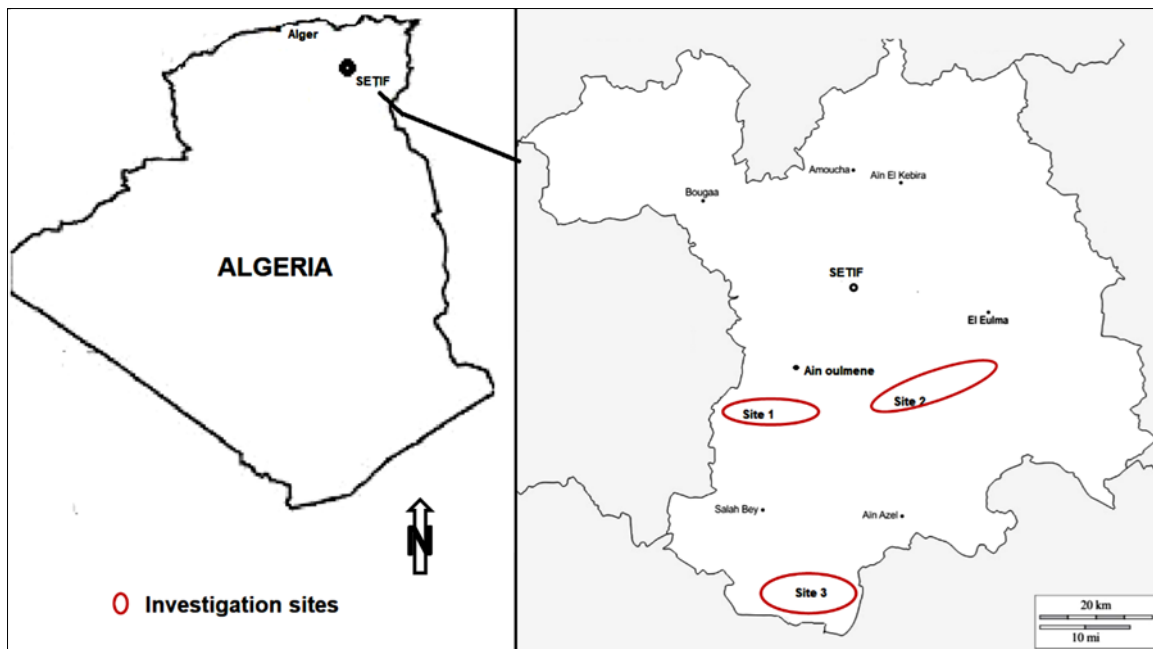


Fig.1. Location of study sites. Site 1: Djebel Zdimm; Site 2: djebel Youssef; Site 3: djebel Boutaleb

The soils of djebel Youssef are shallow stony of two types : bedded black dolomites with intercalation of marly limestones at the base and limestones at the top. While djebel Zdimm shows a succession of coarse limestone and greasy limestone with a marl-limestone bedrock and compact limestones at the top The soils of djebel Boutaleb are calcimagnesian brown limestone and brown calcic soils, these brunified soils are rich in fine silicate elements [12].

The hydrographic network of the delimited sector is organized in its entirety in an endorheic

system. The various wadis correspond to temporary watercourses with a main flow in the form of floods. They drain the massifs towards the permanent wadis, for the northern slopes and towards the closed depressions for the southern slopes. The water regime is very variable depending on the rainfall: rainy years and others dry.

From a biogeographical point of view, the site belongs to the North African steppe domain [13,14], to the highlands sector and sub-sector of the Constantine highlands [15], (Quézel & Santa,

1962-1963). The study area is located in a semi-arid bioclimate below cool winter, with average precipitation estimated at 440.60 mm / year and thermal amplitudes varying between 1.94°C and 37.7°C with a relatively long dry season of 5½ months. Belonging to the semi-arid Meso-Mediterranean vegetation stage [10]. The flora of this ecosystem is remarkable, notably with low matorrals and wooded and chamaephytic steppes [16,17].

2.2. Methodology

Our investigations in the south of Sétif, purely phytocological, are aimed at the search for endemic taxa and the delimitation of their distribution areas for their protection. Our choice is made on the species *Pistacia atlantica* Desf, an endemic tree that has not benefited from a typical ecological study in the Sétif region. This species is reported only in the southern part of the high Sétifian plains in the Boutaleb massif (Sedjar, 2012) and in the steppe region, on djebel Zdimm and djebel Youssef [17].

In addition to these studies and aimed at researching the Atlas pistachio tree, our approach

was to carry out field trips by sweeping all sides of the mountain ranges in the south of Sétif using floristic surveys and the use of GPS. Thus we have had recourse to the topographical maps and flora [15, 18,19]. The delimited sector was subdivided into three distinct sites according to physiographic and floristic criteria. The study period spans 4 years from 2016 to 2019.

3. Results

One of the highlights of the demarcated area is its individualization by stands of *Pistacia atlantica* Desf which constitute the last shrub landscape of the semi-arid Setifien steppe and a buttress against desertification. This endemic species is distributed in a rather small geographical area and found nowhere else in the region of Sétif. It rubs shoulders with many thermo-xerophytic steppe species and coincides with the Meso and thermo-Mediterranean vegetation stage. According to ecological macro-criteria, we can distinguish three localities of the Atlas pistachio (fig.2).

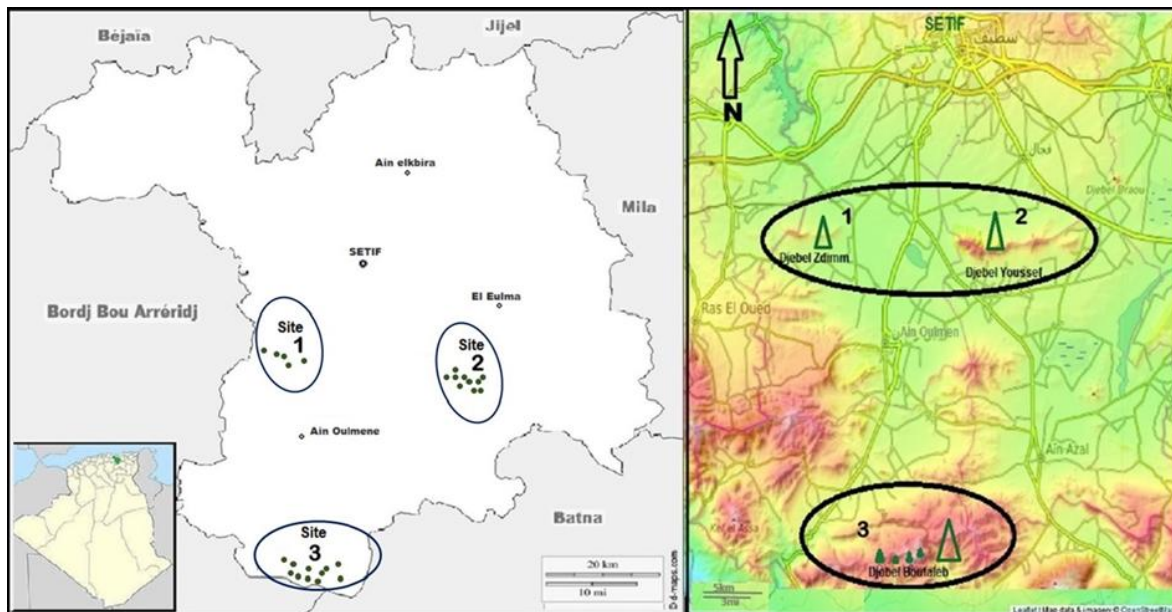


Fig. 2. Range of the Atlas pistachio tree in the south of Setif

Site 1- djebel Zdimm: on its southern flank and particularly in the wooded steppe. The Atlas pistachio tree is scattered in islets of 3 to 7 feet on the reliefs between 1100 and 1200 m of altitude between the thermophilic phanerophytes including *Juniperus phoenicea* L., *Zizyphus lotus* (L.) Desf., *Deverra scoparia* Cosson & Durieu, *Pinus halepensis* Mill. and *Stipa tenacissima* L. This site is distinguished by the presence of a

single and isolated individual of the Atlas pistachio tree (*Betouma maabouda*) at an altitude of 1240m on a vertical cliff. This old and large tree is well preserved by the local population and marabouts, it represents the sacred and oldest tree in this steppe. A similar phenomenon reported Morocco [20], in the eastern region of Morocco where the preservation of the pistachio tree in this area, whose approximate age is approaching

a century, essentially comes down to the belief of the inhabitants.

On the other hand, on the northern slope of this massif, in the chaméphytic steppe, between 1004 and 1180m of altitude, a dozen feet of *Pistacia atlantica* Desf. Are found in a very degraded state accompanied most often by thermo-xerophyte species including *Artemisia herba-alba* Asso, *Astragalus armatus* Willd., *Launaea arborescens* (Batt.)M., *Asparagus albus* L., *Rhamnus lycioides* L., *Asparagus acutifolius* L., *Asparagus stipularis* Forssk., these taxa of rock gardens and pastures, are representative of the most anthropized areas by Djebel Zdimm [10].

Site 2 - djebel Youssef : within the summit formations of this massif, 11 small populations of Atlas pistachio were observed of 4 to 11 individuals on the North and North-West slope with several trees and shrubs thermophiles based on *Crataegus azarolus* L., *Juniperus oxycedrus* L., *Phillyrea angustifolia* L., *Olea europea* L., *Calicotome spinosa* (L.) Link, *Prunus prostrata* Labill., *Quercus rotundifolia* L., *Pinus halepensis* Mill. and *Rhamnus alaternus* L. This formation degraded occupies altitudes between 1270 and 1400m.

Site 3- djebel Boutaleb: on the northern slope of between 1050 and 1300 m is structured by a mixed facies of wooded steppes where the feet of

Pistacia atlantica Desf. are well protected by *Zizyphus lotus* L. and accompanied by *Phillyrea angustifolia* L., *Juniperus phoenicea* L., *Pinus halepensis* Mill. and *Juniperus oxycedrus* L. and *Globularia alypum* L. This site located in the extreme south of the Sétif region, it represents the last pistachio trees in the Atlas of the Setifian region with a population of 58 individuals observed covering an area of approximately 100 m².

4. Discussions

4.1. New range of *Pistacia atlantica* Desf.

According to our investigations in the Sétif region, the Atlas pistachio tree is found only in the south of Sétif. It currently forms degraded stands, rather isolated individuals between steppe vegetation that may be partly linked to the sporadic presence of microhabitats under anthropogenic pressure. This species is well acclimatized in the semi-arid Setifian steppes in the thermo and meso-Mediterranean vegetation stage [17]. On djebel Zdimm, it grows on cliffs at an altitude of 1200 m as well as in the wooded steppe (fig.3). On djebel Youssef and djebel Boutaleb, the Atlas pistachio tree stands out at high altitudes between 1300 and 1400 m.



Fig.3. *Pistacia atlantica* Desf. growing on the northern slope of djebel Youssef (September 2018)

4.2. Habitat and acclimatization

The Atlas pistachio tree is reported as the most original and remarkable species in North Africa. It is a tree par excellence of the dayas of the southern foothills of the Saharan Atlas, its extreme limit is in the heart of the Hoggar where it exists in relic state [2].

It is mainly found in the transition zone between the steppe and the Tell, especially in the western region of Algeria. From East to West it is found in M'Sila, Djelfa, Tlemcen, Saida, Tiaret, Naama, Laghouat, El Bayad, Béchar and

Ghardaia. It is also recorded at the southern limit of Algeria at the level of Hoggar [8]. It is one of the rare tree species still present in semi-arid and arid regions, and even in the Saharan region. This exceptional plasticity vis-à-vis atmospheric drought could be its main character, but it is no less indifferent to the nature of the soil and it can occupy the most extreme situations in its botanical area [2].

The floristic procession of *Pistacia atlantica* Desf is consistent with the bioclimate and its habitat, it is most often associated with *Zizyphus*

lotus, *Juniperus phoenicea*, *Pinus halepensis* and many steppe chaméphytes. This intimate association gives it good protection against winds and entropic action, particularly grazing [10, 21, 22, 20, 24].

The pistachio trees of the Atlas of the High Plains of Setif have a large thermal amplitude and are subject to drastic variations in periods of drought going to more than 5 dry months and strong anthropozoic pressure[17].

4.3. Vulnerability status and protection

As the most original and remarkable species of North Africa, the Atlas Pistachio is one of the rare tree species still present in the semi - arid and arid regions of Algeria [25]. Most of the Atlas pistachio range is in western Algeria. It is a heritage species of global interest.

According to decree n ° 93-285 corresponding to November 23, 1993, *Pistacia atlantica* Desf. is declared in the list establishing the non-cultivated plant species protected throughout the Algerian territory.

Pistacia atlantica Desf. is a species of the future for western Algeria, its resistance to all ecological hazards gives it a special status compared to species from southern Algeria [22]. Depending on the level of exploitation, the decline in the overall size of this species is estimated at 25% over the next 100 years [26].

In the steppe ecosystems of Setif, the Atlas pistachio tree is undergoing severe degradation due to climatic deterioration and strong anthropization. This situation is detrimental to plant resources and the loss of an endemic taxon reported for the first time in the south of Sétif. This makes it possible to attribute to this species the status of rarity in eastern Algeria.

Due to its alarming level of vulnerability, its sustainability and its ecological and socioeconomic interest in the Sétifienne region, it is recommended to establish an emergency intervention plan whose main conservation strategies aim to delimit the protected areas of this species by the creation of plant belts using the thorny and non-palatable or hardly palatable accompanying species originating from these stations such as *Ziziphus lotus* (L.), *Launaea arborescens* (Batt.) M, *Rhus tripartita* (Ucria) Grande, *Thymelaea microphylla* Coss and Dur. *Deverra scoparia* Cosson& Durieu.

Thus a mastery of the knowledge of *Pistacia atlantica* Desf. on its biology and dynamics will allow its extension and maintenance in the future.

The natural conservation of the Atlas pistachio tree is a challenge to be taken up in the Sétif region, given its high vulnerability combined with human pressure and climatic hazards.

Conclusions

The Atlas pistachio tree is a tree well adapted to semi-arid and arid climates. Reported for the first time in the Sétif region, this species is in a precarious and alarming situation because of its extensive degradation. In the absence of a precise delimitation of its distribution area in Algeria, this work allows us to understand to what extent the data on the Algerian Atlas pistachio may still be incomplete and it is necessary that research on *Pistacia atlantica* Desf. should broaden and deepen the spectrum of territorial prospecting surveys of the eastern steppes.

Classified as rare endemic and threatened with extinction in the near future, the Atlas pistachio tree, which occupies a very restricted distribution area in the Sétif region, must urgently receive protection status and multidisciplinary efforts must be deployed. quickly to conserve, support and rehabilitate it in these fragile and vulnerable steppe ecosystems.

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