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WEAKENING RISKS OF THE QUERCUS FAGINEA SUBSP. TLEMCENENSIS (DC.) M. IN TLEMCEN MOUNTAINS (ALGERIA): CASE OF THE NATURE RESERVE OF MOUTAS

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Abstract
The zeen oak (Quercus faginea Lamk.) is a deciduous oak whose presence can range from meso-Mediterranean to the supra-Mediterranean level. It is considered an endemic taxon of the western Mediterranean forest. It would be represented in the Tlemcen Mountains and in particular in the Moutas reserve by a subspecies: Quercus faginea subsp. tlemcenensis (DC.) M. Among the ecological factors that contributes to its weakening and threaten it over the last twenty years. The water deficits recorded in the reserve and mainly due to the shift of ombrotypes from hyper-subhumid to upper semi-arid. However, the taxon shows a better ability to resist these deficits and precipitation breaks by initiating its resilience at the level of depressions benefiting from water compensation.
Keywords: Algeria, bioaggressors, bioclimate, Quercus faginea Lamk, resilience

1. INTRODUCTION

The Tell Atlas Mountains of the Tlemcen region are home to a highly interesting biodiversity, which has generated considerable interest in studying vegetation in these ecosystems. Various ecological niches are integrated into Mediterranean landscapes, punctuated by the endemism of several taxa. The distribution of these taxa is governed by a significant number of ecological factors [1].
The vegetation of the Tlemcen Mountains (Western Algeria) consists of forest formations with oak and coniferous trees. Under the action of climate change and anthropic action, these formations are beginning to lose space in the face of pre-forest formations which in turn are being replaced by other xerophilous species with chamaephytes.
The oak forests of the Tlemcen Mountains are located on a succession of vegetation levels defined for the climatic types whose limits vary with altitude. The Zeen oak (Quercus faginea Lamk.) is a type of oak that inhabits the meso and supra-Mediterranean levels [2-4].
It is classified as an endemic species of the western Mediterranean [5]. It is identified in the western mountains of Tlemcen, particularly in the Moutas reserve, by a subspecies: Quercus faginea subsp. tlemcenensis (DC.) M. This taxa colonizes 1/5 of the Moutas reserve, with an area of 430 ha [2].
It is undergoing a transition in response to climate change through homogeneity with respect to environmental factors that take into account exposure [6] and micro-topography, by recolonizing basins and depressions that receive accumulations of seasonal precipitation.
These topographical characteristics allow it to regain ground through its capacity for resilience, stump rejection and germination in these places [6].
Today, the zeen oak in the Tlemcen Mountains is investing in longevity with a vulnerable phyto-mass.
It happens to be undergoing a bottleneck caused by longer episodic droughts in the region. Its dynamics give it a good ability to compete in mixed stands, particularly holm oak and cork oak [7].
The global warming that the northern hemisphere of the globe is experiencing has caused an ecological upheaval that affects the dynamics of certain endemic species of Mediterranean ecosystems. Quercus faginea subsp. tlemcenensis is an example [7]. The study we have started envisages the development of a phytodynamic typology at the Moutas station [6].
This approach will allow us to analyze and evaluate at a station scale (Protected Reserve) the dynamics of Quercus faginea subsp. tlemcenensis in relation to some ecological factors that weaken it or threaten its regeneration [8].
An overview is given to some pathogenic insects of Quercus faginea at the Moutas station.
These include Cynips quercusfolii and Corythucha arcuata. Pests of sessile oaks in particular and which until now their effect on the taxon has not been declared harmful [9].

2. MATERIALS AND METHODS

2.1. Study area

The Moutas reserve is located in the northwestern part of Algeria, approximately 46km as the crow flies from the sea and 26 km southwest of the city of Tlemcen (Fig.1). It is part of the Hafir national forest, and occupies the highest and most wooded area of the Tlemcen Mountains. It is located around the intersection of the parallel 34°41' at 49' north latitude and the meridian 01°25'at 35'west longitude [10].

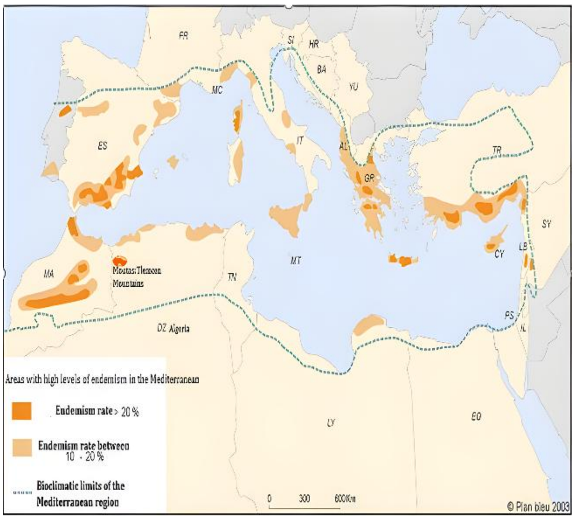

Figure 1. **Map of Areas with high levels of endemism in the Mediterranean including Moutas: Tlemcen Mountains [25]**

The Site occupies an area of 2156 hectar over a perimeter of 15 km, characterized by a typically mountainous relief with steep slopes, where very variable differences in level are combined, containing high massifs with steep rocky peaks by areas of flattened plains.

The slopes vary between 12 and 25% within the limits of the fenced territory. Outside the reserve, the slopes become more significant [10].

A geological synthesis shows that the substrate that makes up the study area is formed essentially of limestone and dolomites. These two more or less hard sedimentary rocks are easily erodible.

This gives a karstified appearance to the dolomite and the cliff [11].

The work of Benest et al. [11] specifies that the substrate is characterized by carbonate rocks of Upper Jurassic age and sandstone marls of Tertiary age. The lithology is heterogeneous; it is formed essentially by laminated marl formations and well-individualized lacustrine limestone [11].

2.2. Climate overview

In order to follow the dynamics of the evolution of the floristic procession accompanying the oak groves of the Moutas station. The climate is of particular interest because it is a determining factor in the study. A comparison of the results obtained from the old climate data (1913-1938) of Seltzer (1946) [12] and that of the recent data (2000-2020) of O.N.M. (2020), shows that the Moutas region is characterized by a Mediterranean-type climate with two bioclimatic stages, the semi-arid and the Sub-humid with cool winters.

The annual average rainfall is 496.90 mm, the coldest month is usually January with the minimum (m) of 3.4°C, while the maximum averages (M) of the hottest month in August with 31.35°C.

2.3. Phytoecological study

The sampling of vegetation in the Moutas reserve was carried out from 100 phytoecological surveys that allowed us to inventory part of the floristic richness. With the Braun-Blanquet [13] and Guinochet [14] method used for sampling vegetation. We used the method of surface surveys (minimum area) reinforced by linear surveys (transects). Which consists of choosing locations as typical as possible in which the *Quercus faginea* population continues to evolve in a natural way or forced by a stressful environment in perpetual mutation, and in correlation with the conditions of the environment. It is located essentially on a siliceous substrate and very rarely calcareous. This zonation changes considerably depending on the topography [14]. The study area has a total of 151 taxa (Table 1).

The basic work used for the identification of the taxa collected in the field is based on the studies carried out by Quézel and de Santa [10], Battandier and Trabut [15], Blanca et al., [16], Maire [17], Dobignard [18], Di Pietro et al. [19]. It is on the linear surveys that our attention was focused.

Table 1. Species surveys constituting the biodiversity of the Moutas reserve

Taxons	Family	M.T	B.T	Biog.T	Rarety	Q.R	R	E.R	End .	End . NA	Protection statut
Allium chamaemoly	Alliaceae	P.H.	Ge	MED.	C/ R.R			+			+
Pistacia lentiscus	Anacardiaceae	W.P.	Ph	MED.	CC						++
Pistacia terebinthus	Anacardiaceae	W.P.	Ph	MED.	AC/ R		+			+	
Apium nodiflorum	Apiaceae	A.H.	Th	MED-ATL.	-						
Daucus carota	Apiaceae	A.H.	Th	MED.	R		+				
Daucus muricatus	Apiaceae	A.H.	Th	COSM.	CC						
Eryngium campestre	Apiaceae	P.H.	Ch.	W-MED.	AR/ RR	+					
Eryngium tricuspidatum	Apiaceae	P.H.	Ch.	W-MED.	CC						
Ferula communis	Apiaceae	P.H.	Ch.	MED.	CC						
Foeniculum vulgare	Apiaceae	P.H.	Ch.	MED.	CC						
Arisarum vulgare	Araceae	A.H.	Ge	CIRCUMMED.	R		+				
Aristolochia longa	Aristolochiaceae	A.H.	Th	MED.	R		+				
Asparagus acutifolius	Asparagaceae	P.H.	Ge	MED.	CC/AR	+					
Asparagus albus	Asparagaceae	P.H.	Ge	W-MED.	C						
Asphodelus microcarpus	Asphodélaceae	P.H.	Ge	CANAR-MED.	CC						
Andryala integrifolia	Asteraceae	A.H.	Th	W-MED.	CC						
Anthemis pedunculata	Asteraceae	P.H.	He.	LBERO-MAUR.	R						
Anthemis punctata	Asteraceae	A.H.	Th	MED.	R						
Bellis sylvestris	Asteraceae	A.H.	Th	CIRCUMMED.	Var						
Calendula suffruticosa	Asteraceae	A.H.	Th	ESP-NA.	Var						
Carduus pycnocephalus	Asteraceae	P.H.	Ch.	EURAS.	Var						
Catananche caerulea	Asteraceae	P.H.	Ch.	W-MED.	R		+				
Chrysanthemum grandiflorum	Asteraceae	P.H.	He.	END.	CC				+		
Echinops spinosus	Asteraceae	P.H.	Ch.	S-MED-SAH.	CC/AC						
Pallenis spinosa	Asteraceae	W.P.	Ch.	EUR-MED.	CC /AC						
Phagnalon saxatile	Asteraceae	P.H.	Ch.	W-MED.	Var						
Pulicaria odora	Asteraceae	P.H.	Ch.	CIRCUMMED.	CC						
Scolymus grandiflorus	Asteraceae	P.H.	Ch.	EUR-MED.	AR	+					
Scolymus hispanicus	Asteraceae	P.H.	He.	MED.	CC						
Senecio vulgaris	Asteraceae	P.H.	Ch.	SUB-COSM.	CCC						
Biscutella didyma	Brassicaceae	H.A.	Th	MED.	CC						
Briza maxima	Brassicaceae	A.H.	Th	SUB-TROP.	CC						
Draba verna	Brassicaceae	A.H.	Th	EURAS.	R		+				
Lobularia maritima	Brassicaceae	A.H.	Th	MED.	CC						
Raphanus raphanistrum	Brassicaceae	A.H.	Th	MED.	R		+				
Sinapis arvensis	Brassicaceae	A.H.	Th	PALEO-TEMP.	R		+				
Thapsia garganica	Brassicaceae	W.P.	Ch.	MED.	CC						
Vella annua	Brassicaceae	A.H.	Th	MED.	AC						
Campanula dichotoma	Campanulaceae	W.P.	Ph	MED.	Var						
Lonicera implexa	Caprifoliaceae	W.P.	Ch.	MED.	RR			+			
Viburnum tinus	Caprifoliaceae	W.P.	Ch.	MED.	CC						
Paronychia argentea	Caryophyllaceae	P.H.	He.	EUR-MED.	C						
Silene tridentata	Caryophyllaceae	A.H.	Th	MED.	R		+				
Stellaria media	Caryophyllaceae	A.H	Th	COSM.	C						
Cistus albidus	Cistaceae	P.H	Ch.	MED.	AC						
Cistus ladaniferus	Cistaceae	P.H	Ch.	MED.	CCC						
Cistus salvifolius	Cistaceae	P.H	Ch.	EURAS-MED.	CC						
Cistus villosus	Cistaceae	P.H	Ch.	EURAS-MED.	Var						
Helianthemum hirtum	Cistaceae	P.H	Ch.	IBERO-MAUR.	R		+				
Tuberaria guttata	Cistaceae	A.H.	Th	MED.	Var						
Tuberaria vulgaris	Cistaceae	W.P.	Ch.	W-MED.	R		+				
Convolvulus althaeoides	Convolvulaceae	A.H.	Th	MACAR-MED.	CC						
Sedum sediforme	Crassulaceae	A.H.	Th	MED.	C						
Cupressus sempervirens	Cupressaceae	W.P.	Ph	END.	A.C						
Juniperus oxycedrus	Cupressaceae	W.P.	Ph	ATL-CIRCUMMED.	R					+	+
Tetraclinis articulata	Cupressaceae	W.P.	Ph	IBERO-MEURIT-MALTE	RR			+			
Carex halleriana	Cyperaceae	P.H.	Ch.	MED.	C						
Dipsacus silvestris	Dipsacaceae	A.H.	Th	EURAS.	CC						
Scabiosa stellata	Dypsacaceae	A.H.	Th	W-MED.	RR			+			
Arbutus unedo	Ericaceae	W.P.	Ph	MED.	RR			+			
Erica arborea	Ericaceae	W.P.	Ch.	MED.	RR			+			
Euphorbia exigua	Euphorbiaceae	A.H.	Th	W-MED.	CC						

Euphorbia falcata	Euphorbiaceae	A.H.	Th	MED-AS.	AC						
Anthyllis tetraphylla	Fabaceae	A.H.	Th	MED.	R		+				
Anthyllis vulneraria	Fabaceae	A.H.	Th	EUR-MED.	Var						
Calycotome intermedia	Fabaceae	A.H.	Ch.	MED.	C						
Ceratonia siliqua	Fabaceae	W.P.	Ph	MED.	R		+				
Cynoglossum cheirifolium	Fabaceae	A.H.	Th	MED.	C						
Cytisus triflorus	Fabaceae	W.P.	Ph	W-MED.	R		+				
Genista tricuspidata	Fabaceae	P.H	Ch.	END-NA.	Var						
Junceum spartium	Fabaceae	W.P.	N.Pha.	W.Med	AR	+					
Carthamus caeruleus	Asteracea	P.H.	Ch	Med.	CCC						
Lagurus ovatus	Fabaceae	A.H.	Th	MACAR-MED.	CC						
Lathyrus sphaericus	Fabaceae	A.H.	Th	MED.	C						
Lotus edulis	Fabaceae	A.H.	Th	MED.	C						
Medicago minima	Fabaceae	A.H.	Th	EUR-MED.	R		+				
Odontites purpurea	Fabaceae	A.H.	Th	IBERO-MAUR.	CC						
Trifolium angustifolium	Fabaceae	A.H.	Th	MED.	C						
Trifolium campestre	Fabaceae	A.H.	Th	PALEO-TEMP.	R		+				
Ulex boivini	Fabaceae	W.P.	Ch.	IBERO-MAUR.	R		+				
Vicia angustifolia	Fabaceae	A.H.	Th	W-MED.	R		+				
Vicia sativa	Fabaceae	A.H.	Th	EUR-MED.	Var						
Quercus coccifera	Fagaceae	W.P.	Ph	W-MED.	R		+				
Quercus faginea subsp.Tlemcenensis	Fagaceae	W.P.	Ph	MED-ATL.	R		+		+		++
Quercus ilex	Fagaceae	W.P	Ph	MED.	R		+				
Quercus suber	Fagaceae	W.P	Ph	W-MED.	R		+				+
Erodium moschatum	Geraniaces	A.H.	Th	MED.	CC						
Geranium molle	Geraniaces	A.H	Th	COSM.	CC						
Geranium robertianum	Geraniaces	A.H.	Th	COSM.	R		+				
Teucrium fruticans	Lamaiceae	W.P.	Ch.	MED.	R		+				
Calamintha nepeta	Lamiaceae	P.H	He.	EURAS.	AR	+					
Lavandula dentata	Lamiaceae	P.H.	Ch.	W-MED.	RR			+			
Lavandula stoechas	Lamiaceae	P.H.	Ch.	MED.	CC						
Nepeta multibracteata	Lamiaceae	P.H.	He.	PORTUGAL.NA	AC						
Origanum glandulosum	Lamiaceae	P.H	He.	ALG.TUNIS	C						
Rosmarinus officinalis	Lamiaceae	W.P	Ch.	MED.	C						
Salvia verbenaca	Lamiaceae	P.H.	He.	MED-ATL.	Var						
Teucrium polium	Lamiaceae	A.H.	Th	EUR-MED.	R		+				
Thymus ciliatus	Lamiaceae	W.P	Ch.	END-NA.	Var					+	
Prasium majus	Lamiaceae	W.P	Ch.	MED.	CC						
Galium aparine	Liliaceae	A.H	Th	PALEO-TEMP.	Var						
Ornithogallum umbellatum	Liliaceae	P.H	Ge	CIRCUMMED.	C						
Ruscus aculeatus	Liliaceae	P.H.	Ge	MED-ATL.	C						
Smilax aspera	Liliaceae	W.P	Ch.	MACAR-MED-ETHIOP-INDE	C						
Urginea maritima	Liliaceae	P.H.	Ge	CANAR-MED.	AC						
Asparagus stipularis	Liliaceae	P.H	Ge	MACAR-MED.	A.C						
Linum strictum	Linaceae	A.H	Th	MED.	AC						
Linum suffruticosum	Linaceae	W.P	Ch.	W-MED.	R		+				
Malva sylvestris	Malvaceae	P.H.	He.	EURAS.	CC						
Olea europaea	Oleaceae	W.P.	Ph	MED.	CC						
Olea europaea var. oleaster	Oleaceae	W.P.	Ph	MED.	R		+				
Phillyrea angustifolia	Oleaceae	W.P.	Ph	MED.	Var						
Orobanche alba	Orobanchaceae	W.P.	Ch.	EURAS.	RR			+			
Chamaerops humilis	Palmaceae	W.P.	Ph	W-MED.	CC						
Papaver rhoeas	Papaveraceae	A.H.	Th	EUR-MED.	C						
Cedrus atlantica	Pinaceae	W.P.	Ph	ORO-MED.	AC						
Pinus halepensis	Pinaceae	W.P.	Ph	MED.	CC						
Plantago albicans	Plantaginaceae	W.P	Ph	MED.	CC						
Plantago lagopus	Plantaginaceae	A.H.	Th	MED.	CC						
Aegilops geniculata	Poaceae	A.H.	Th	MED-IRANO-TOUR.	-						
Aegilops triuncialis	Poaceae	A.H.	Th	W-MED.	RR			+			
Aegilops ventricosa	Poaceae	A.H	Th	W-MED.	AR	+					
Ampelodesmos mauritanicus	Poaceae	W.P.	Ch.	W-MED.	R		+				
Ampelodesmos mauritanicus	Poaceae	P.H.	Ch.	W-MED.	C						
Avena sterilis	Poaceae	A.H.	Th	MACAR-MED-IRANO-TOUR.	CC						

Brachypodium distachyon	Poaceae	A.H	Th	PALEO-SUBTROP.	CC							
Bromus madritensis	Poaceae	A.H	Th	EUR-MED.	Var							
Bromus rubens	Poaceae	A.H.	Th	PALEO-SUBTROP.	R		+					
Dactylis glomerata	Poaceae	P.H	He.	PALEO-TEMP.	C							
Festuca caerulescens	Poaceae	A.H.	Th	END-NA.	C.C/ R		+					
Hordeum murinum	Poaceae	A.H.	Th	CIRCUM-BOR.	AR	+						
Lamarckia aurea	Poaceae	A.H.	Th	MACAR-MED-ETHIOPIE	CC							
Melica minuta	Poaceae	A.H.	Th	MED.	C							
Stipa tenacissima	Poaceae	P.H.	He.	IBERO-MAUR.	E				+			
Vulpia geniculata	Poaceae	A.H.	Th	W-MED.	-							
Anagallis arvensis	Primulaceae	A.H.	Th	SUB-COSM.	Var							
Anagallis monelli	Primulaceae	P.H	He.	W-MED.	Var							
Asterolinum linum-stellatum	Primulaceae	A.H.	Th	MED.	CC							
Nigella damascena	Renonculaceae	A.H.	Th	MED.	C							
Ranunculus bulbosus	Renonculaceae	P.H	He.	EURAS.	R		+					
Reseda alba	Resedaceae	P.H.	He.	EURAS.	Var							
Rhamnus alaternus	Rhamnaceae	W.P.	Ph	MED.	Var							
Rhamnus lycioides	Rhamnaceae	W.P.	Ph	W-MED.	AC							
Crataegus monogyna	Rosaceae	W.P.	Ph	EUR-MED.	C							
Rosa sempervirens	Rosaceae	W.P.	Ch.	MED.	R		+					
Rubus ulmifolius	Rosaceae	W.P.	Ch.	EUR-MED.	C							
Sanguisorba minor	Rosaceae	P.H.	He.	EURAS.	Var							
Rubia peregrina	Rubiaceae	P.H	He.	MED-ATL.	CC							
Ruta chalepensis	Rutaceae	W.P.	Ch.	MED.	C							
Daphne gnidium	Thymeleaceae	P.H.	Ch.	MED.	C							
Valerianella tuberosa	Valerianaceae	P.H.	Ch.	MED.	-							

Note:
Rarety: QR: Quiet Rare; R: Rare; ER: Extremely rare; R.R: Very rare; C: Common; A.C: Quite common; C.C.C: Extensive; C.C: Very common; A.R: Quite common; Var: With variety
Endemicity: End. N.A: Endemic North Africa; End Alg-Tun: Endemic in Algeria and Tunisia; End: Endemic.
Biologic types B.T: Ph: Phanerophytes; N.Ph: Nano-phanerophytes; Ch: Chamaephytes; Th: Therophytes; He: Hemicryptophytes; Ge: Geophytes
Morphologic types M.T: P.H: Perennails Herbaceous; W.P. Woody perennials; H.P. Annual herbaceous
Biogeographic types Biog.T: Atl-Circum-Med. Atlantique Circum-Mediterranean; Can-Med: Canarien-Mediterranean Circumbor: Circumboreal; Circum-Med: Circum-Mediterranean; Cosm: Cosmopolite; End: Endemic; End-NA: Endemic North-African; Eur. Europeen; Eur-Med: European-Mediterranean ; Euras: Eurasiatique; Euras-NA-Trip: Eurasiatique-North Africain-Tripolitaine; Euras-Med: Eurasiatique- Mediterranean; Eur-Merid-NA: European-Meridional North African; Ibero-Maur: Ibero-Mauritanien; Ibero-Maurit-Malte: Ibero-Mauritanien-Malte; Macar-Med: Macaronesian- Mediterranean; Macar-Med-Irano-Tour: Macaronesian-Mediterranean-Irano-Touranien; Med: Mediterranean; Med-Atl: Méditerranean- Atlantique; Med-Irano-Tour: Mediterranean-Irano-Touranien; N-A-Trip: Nord-Africain Tripolitaine; N-A: Nord-Africain; Paleo-Subtrop: Paleo-Sub-Tropical; Paleo-Temp: Paleo-temperate; Sah: Saharian; Sub-Cosm: Sub-Cosmopolite; S-Med-Sah: Sud-Mediterranean-Saharian; Sub-Med: Sub-Mediterranean; W-Med: West-Mediterranean.

3. RESULTS

3.1. Bioclimate

Moutas reserve, at an altitude of 1215m, and a coverage rate of 60% of sylvatic flora. The bioclimates are identifiable by calculating the annual ombrothermic index Io and the simple continentality index Ic [20]. These indices are calculated for the entire study region, where Ic < 1.70 and Io > 2.10.
According to the thresholds proposed in W.B.C.S., the study area belongs to the Mediterranean pluvioseasonal oceanic climate (Ic < 21 and Io > 2).
The continentalityindex expresses in degrees centigrade the difference or oscillation between the average temperature of the warmest month (T^{max}) and the average temperature of the coldest month (T^{min}) of the year [21-22].

The values of this index are between 14.70 and 17.60. According to the classification adopted by W.B.C.S. [22], the study area, which covers an area of 514.35 km^2, is of the “Oceanic” type. It is divided into two subtypes, one “Eu-oceanic”, and “Semi-continental”.
The latter extends on the southern slope [23].
From the results obtained, the values of the Ombrothermic index "Io" vary from 2.30 to 5.10. Following the ranges of the annual gradient of "Io" in WBCS, two types of Ombroclimates can be characterized in the study area: Upper semi-arid for recent data and, Upper sub-humid for old data (1913-1938) (Table 2).

Table 2. Climate types, bioclimatic stages, thermotypes and ombrotypes

Stations	(M-m) °C		Climate types		Bioclimatics stages		Thermotype		Ombrotype	
	1913-1938	2000-2020	1913-1938	2000-2020	1913-1938	2000-2020	1913-1938	2000-2020	1913-1938	2000-2020
Moutas	28.7	29.89	Semi-continental	Semi-continental	Medium sub-humid winter	Upper semi-arid with cold winters	Supra mediterranean	Meso-mediterranean	Hyper-Sub-humide	Upper semi-arid

Furthermore, the calculation of the thermal index (It), the compensated thermal index (It_c) and the positive temperature (Tp) allowed us to differentiate two types of bioclimate: Supra-mediterranean (1913-1938) and Meso-mediterranean ($210.41 < Itc < 413.23$). The number of dry months was calculated for all data extracted from World. Clim [23- 26] while considering that a month is dry when the P/T ratio is less than 2. The $P/T < 2$ relationship allowed us to identify a dry period of five months and which extends from June to October for the entire study area [8]. A bioclimatic study spread over the last century by Ghenim and Megnounif [24] on the Tlemcen Mountains and in particular the Moutas station. Reveals that rainfall in the region has been marked by a downward trend. The deficits are mainly due to the shift from the wet period to the dry period illustrated by the passage of ombrotypes from hyper-subhumid to upper semi-arid [25]. The ratio of the averages of the two periods makes it possible to estimate the rainfall deficits caused by the two periods from 25% to 37%.

3.2. Phytoecological dynamics

On the southern slopes of the mountains of the Moutas station, a particular plant group with *Quercus faginea* subsp. *tlemcenensis* was identified. This is a mixed set with *Quercus ilex* subsp. *rotentifolia* developing in mosaic in fidelity with species such as *Asparagus acutifolius* L., *Spartium junceum* L., *Carthamus caeruleus* L., *Cytisus arboreus* subsp. *baeticus* (Webb) Maire., *Cistus monspeliensis* L., *Lathyrus sphaericus* Retz., *Ruscus aculeatus* L., *Smilax aspera* L., *Viburnum tinus* L., *Lonicera implexa* L., *Pistacia terebinthus* L., *Erica arborea* L., *Rhamnus alaternus* L. [7-8]. It appears as open stands penetrated by *Rosmarinus officinalis* L. and *Daphne gnidium* L., the *Globularia alypum* L. which here replaces the (Diss) *Ampelodesma mauritanicum* (Poiret) Dur. This plant association has undergone terrible degradation during the rainfall deficits recorded from 2011 to 2020 (Fig. 2).

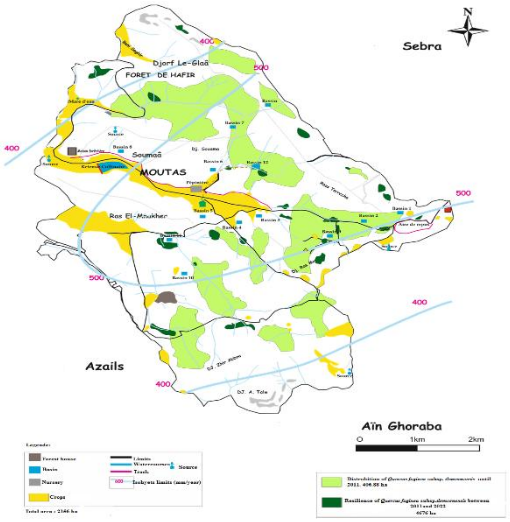

Figure 2. Map of distribution resilience of *Quercus faginea*subsp. *tlemcenensis* Moutas reserve [6]

This has caused *Quercus faginea* subsp. *tlemcenensis* to lose a lot of surface area and to occupy 80% of the plains at the bottom of the slopes, taking advantage of the water compensation [7] (Fig. 3).
It is also important to note that the formations of *Quercus faginea* subsp. *tlemcenensis* have difficulty maintaining at the level of certain high reliefs in affinity with those of *Quercus ilex*. The resilience and the shoots of stumps are visible; at the level of the lower slopes due to the germination of acorns [26]. By comparing floristic inventories carried out in 2000 and 2020 in the same stations, it was deduced that this type of vegetation is enriched in therophytes showing both degradation due to arid periods of drought [8].

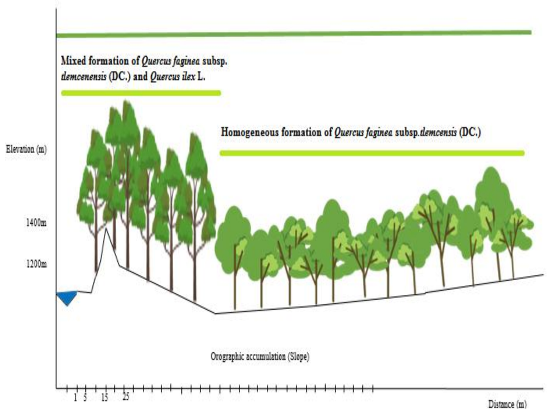

Figure 3. Linear transect of the distribution of *Quercus faginea* subsp. *tlemcenensis* in Moutas according to the slope [14]

3.3. Phytodiversity

The sampling of vegetation in the Tlemcen Mountains region carried out from 100 phytoecological surveys allowed us to inventory part of the floristic richness [9]. We have inventoried 151 species (Table 1) divided into 43 families. The distribution of families is heterogeneous. Asteraceae present a percentage of 15%, Poaceae 14%, Fabaceae 08% and Lamiaceae 7% (Fig. 4).

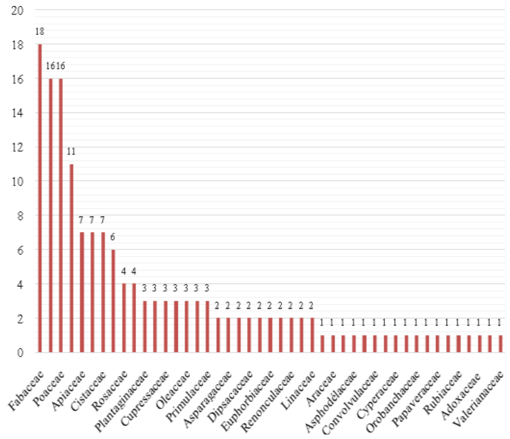

Figure 4. Representation of flora by family

The distribution of biological types in plant formations in all stations remains relatively heterogeneous [27]. They follow the following patterns: Moutas: Therophytes > Chamephytes > Phanerophytes > Hemicryptophytes > Geophytes. The analysis of the biological types of the inventoried species shows the predominance of therophytes 40% (Fig. 5). This therophytization is closely linked to the aridification that the area has experienced in recent years [9].

Chamaephytes come in second place with 28% because they adapt better to drought, they are more xerophilous, and generally, they produce a lot of seeds [28]. Hemicryptophytes and Geophytes are well represented. This can be explained by the high altitude and the richness of the soil, in organic matter which moreover constitutes a good refuge [29]. Phanerophytes represent 15% and are moderately present but they sometimes dominate by their phytomas [8-9].

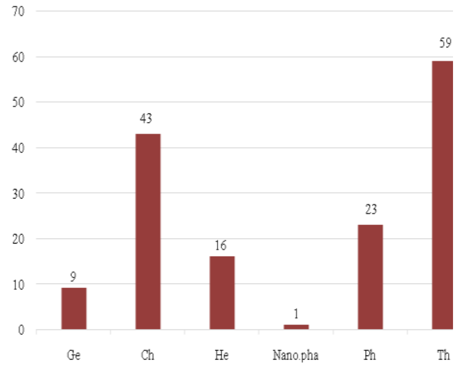

Figure 5. Biological types

The morphological types are marked by heterogeneity of plant formations between woody and herbaceous plants and between perennials and annuals herbaceous plants dominate with a percentage of 41%, and then come perennial herbaceous plants with 32% and finally perennial woody plants with 27% (Fig. 6).

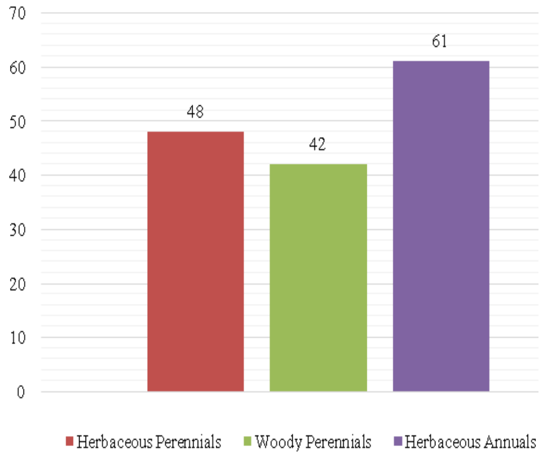

Figure 6. Morphological types

Finally the Mediterranean biogeographic type dominates the station. The Mediterranean elements present a percentage of 36% followed by the West Mediterranean 15%, the Euro-Mediterranean 7% and finally 5% for the Euro-Asian elements (Fig. 7).

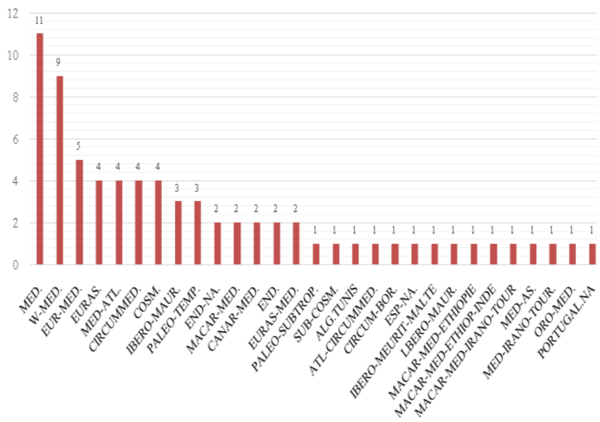

Figure 7. Biogeographical types

3.4. Endemic set

With 14 species, the number of endemic species includes in order of importance the rare endemic element with 09 species and 5.96% of the flora inventoried, then come the pure endemics represented by 3 species 1.98% followed by the North African endemics 02 species (1.32%). On the other hand, rare species are widely represented with a number of 32 (21.19 %) (Fig. 8). Five species are declared protected; these are *Alium chamaemoly* L., *Juniperus oxycedrus* L., *Pistacia lentiscus* L., *Quercus faginea* subsp. *tlemcenensis* and (DC.) M., *Quercus suber* L. representing 3.31%.

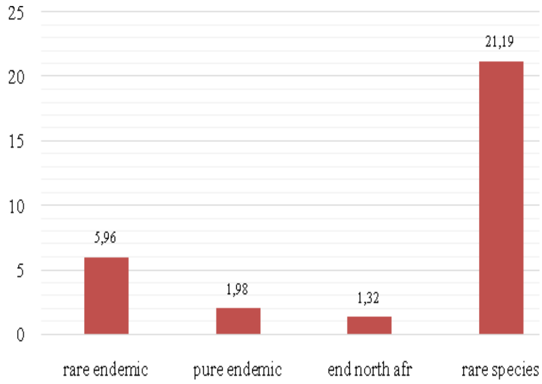

Figure 8. Endemic percentage

3.5. Bio-aggressors

Laboratory tests on samples of *Quercus faginea* subsp. *tlemcenensis* leaves taken in the spring from the Moutas reserve have shown that the infestation by *Corythucha arcuata* commonly called the lattice bug or the oak tiger bug due to its proximity to the plane tree tiger bug (*Corythucha ciliata*) [30].

It is an invasive bug native to western North America. This bug, from the Tingidae family, is recognizable by the reticulated appearance of its thorax and elytra.

Corythucha arcuata spends the winter as an adult under the bark of trunks and migrates to the leaves as soon as they appear in spring. The adult measures about 3.5 mm and lives on the underside of the leaves (Fig. 9).

In the USA, the lattice bug is considered a factor in weakening heavily attacked trees. But it is mainly an insect that affects ornamental plantations (parks and gardens, alignments) [30].

Considering the little damage caused by this species in its native range and by similarity with the minimal consequencesof the introduction of the plane tree tiger in Europe in 1964. We can think that the damage to infested oaks will also remain minimal in our area [30].

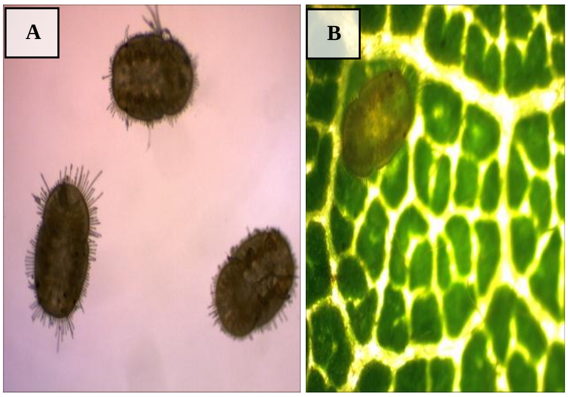

Figure 9. Photo of *Corythucha arcuata* larvae (100 X180µm) (Benkhelifa 2023): A. Isolated *Corythucha arcuata* larvae; B. *Corythucha arcuata* larva on *Quercus faginea* leaf

It is also important to note that *Quercus faginea* subsp. *tlemcenensis* at the Moutas reserve has a very large number of species of galls of very varied size, shape and color (Fig. 10). Including the famous cherry scab "*Cynips quercusfolii*" (Fig 10.A). Which is a "Galleon" or an outgrowth appearing on plant tissue, caused by a pathogen (animal). Indeed, this gall is caused by the laying of eggs by a small hymenopteran insect "wasp" *Cynips quercusfolii*. So far, the oak does not seem to suffer from its effect [5]. Also when walking in the forest in autumn, we notice very round and flat galls, slightly rough, pale green, yellow or brown in colour, attached to fallen leaves (underside, on the vein) (Fig. 10 B). Coming from another hymenoptera which is one of the very many species associated with the oak which is today designated by some ecologists as a species of "biodiversity hotspots". It is the larva of the small solitary wasp *Neuroterus numismalis*. These small galls are produced by the oak in reaction to the injection into the leaf of an egg laid under its surface. These "buttons" fall to the ground in autumn [9].

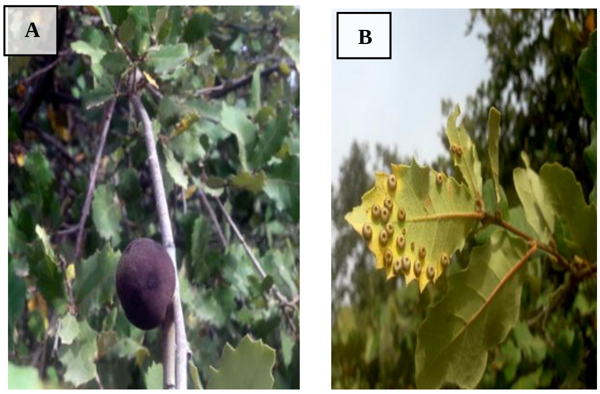

Fig. 10. Photos of oak Galls of [14].
A. Spherical-shaped tubercule, chestnuts gall (*Cynips quercusfolli*)
B. Round and flats galls occur on the surface of the gall localized at the abaxial (*Neuroterus numismalis)*

3.6. Fire action

The biodiversity of the Moutas reserve contains, pyrophytic formations such as, *Cistus ladaniferus* L., *Cistus villosus* L., *Thymus ciliatus* L. The presence of other Lamiaceae, Papilionaceae and Cistaceae can also accelerate fires [14].
In Mediterranean forests and scrublands, fire plays an important and complex role in the balance of vegetation [8]. The role of fire is difficult to identify with certainty because, in nature it is always associated with other factors of evolution such as grazing and various anthropogenic actions [31].
Due to the protected status of the reserve, the frequency of fire is controlled and therefore still poorly understood. However, the high presence in our surveys of active pyrophytes (*Quercus suber* L.) and passive pyrophytes (*Quercus coccifera* L., *Tetraclinis articulata* (Vahl.) Mast. and *Phylleria angustifolia* L. suggests that we are dealing with plant groups for which fire has a great influence on vegetative stimulation and growth [26].

4. DISCUSSIONS

The zeen oak is considered a representative species of the Mediterranean flora by different geobotanical syntheses. Its marcescent (sclerophyllous) leaves are characterized from other evergreen oaks developed as an evolutionary response to the potentially stressful situations imposed by the Mediterranean-type climate, hot and dry summers and cold winters.
Nevertheless, the evolutionary origin of this taxon can be traced back to pre-Mediterranean lineages living in humid, tropical or subtropical climates. In fact, most species of the *Faginea* section now inhabit territories with temperate climates, which benefit from a greater amount of precipitation and cold than those of *Quercus ilex* L. subsp. *rotundifolia* (Lam.) or *Quercus coccifera* L. The lack of information on the response of *Quercus faginea* subsp. *tlemcenensis* to the water stress experienced by the Tlemcen Mountains and western Algeria in general in recent years has allowed us to look into the bottleneck experienced by this species. This study was supplemented by diagnostics, which allowed us to perform a meta-analysis on synergistic threats, including bio-aggressors that so far do not constitute a lethal threat to the taxon. The few studies published previously did not help us to make a comparison to a considerable degree, taking into account intra-species variability in the ability to cope with water stress in terms of vulnerability [32].
The literature reviewed for this study has few works that have highlighted the physiognomic distribution of *Quercus faginea* subsp. *tlemcenensis* along its bioclimatic level and according to old and recent climate databases. Apart from the work of Bouazza et al., [1] interspersed with a few descriptive approaches within the local or regional floristic procession. Which brought a contribution to the cartographic knowledge of the *Quercus faginea* subsp. *tlemcenensis* stand of the Moutas reserve Tlemcen in the North-West of Algeria), no other work has come to understand the multiple forms of adaptation to global changes experienced by *Quercus faginea* subsp. *tlemcenensis* stands in the Tlemcen mountains [8].
This study allowed us to identify the major ecological factors that affect the sensitivity of *Quercus faginea* subsp. *tlemcenensis*, a species endemic to the sclerophyll forests of the Tlemcen Mountains [33]. Ecological parameters synergistic to its dynamics and its evolution within its floristic procession have been taken into account in particular the study of the biodiversity of its populations [8].
A bioclimatic study based on the comparison of climate data over time slices of old data (1913-1938) and recent data (2000-2020) was carried out. Finally, we identified some pathogens or bio-aggressors that can possibly weaken its resilience. It is deduced that this taxon shows a better ability to resist the precipitation deficits that the region is experiencing, due to global warming [9- 14]. It settles slowly due to its resilience in depressions, taking advantage of water compensation which generally offers it better resistance including recovery, and therefore resilience. It also maintains itself in combination with *Quercus ilex* L. subsp. *rotundifolia* (Lam.) on sloping reliefs [33]. Its management should be focused on maintaining its protection, the only initiatives that could constitute a possible strategy to maintain its growth and resilience in the reserve since its dynamics are well correlated with the effect of climate [34].

5. CONLUSIONS

This work reinforces an approach to the management of a Mediterranean natural area classified as a Hotspot and witch need long-term monitoring. The only means capable of feeding biodiversity indicators [33].
Overall, the analysis of these results revealed that the zeen oak is characterized by a conservative strategy, oriented by an orographic gradient. Its resilience strength after a period of stress is of paramount importance for its maintenance in the area.
Finally, in addition, very restrictive limitations to the plant to open stomata and perform photosynthesis due to its water-saving strategy. A large number of Mediterranean endemic taxa are facing current droughts and experiencing stressful conditions imposed by global changes that impose a trade-off between maintenance and survival [28].

6. ACKNOWLEDGEMENTS

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7. CONFLICT OF INTEREST

There is no actual or potential conflict of interest in relation to this article.

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