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Short Communication: Habitat characterization of *Aristolochia baetica* L. in Tessala Mount, Western Algeria

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Abstract. *Zahra H, Zoheir M, Ali L, Kouider C, Amel A. 2018. Short Communication: Habitat characterization of* Aristolochia baetica *L. in Tessala Mount, Western Algeria. Biodiversitas 19: 1632-1641.* The aim of the current investigation was to study the characterization of the habitat of *Aristolochia baetica* L., an Ibero-Mauretanian species, present in Tessala Mount (West of Algeria). Twenty-four phytoecological surveys were realized on eight stations (St1-St8) in which the species is present. The floristic inventory allowed us to identify 68 species which are part of the floristic of *A. Baetica*, distributed in 31 botanical families; 6 biological and 19 biogeographical types. The assessment of edaphic and plant data using correspondence factor analysis (CFA) and hierarchical ascending classification (HAC) showed that *A. baetica* is a member of plant training of scrublands and grows especially in stations at low heights with a high rate of limestone.

Keywords: *Aristolochia baetica*, habitat, Ibero-Mauretanian, Tessala Mount

INTRODUCTION

The Mediterranean region forms a climatic and biogeographical entity enriched with floral elements and very contrasted climates (Gamisans 1991; Quézel 1995). This area is characterized by an exceptional biodiversity too (Cowling et al. 1996) and a raised richness of rare vegetation, mainly concentrated in large plant families (Dominguez Lozano and Schwartz 2005). The reason for what this region was classified as one of the five regions of the world where the environmental issues are the most important (Ramade 1993; Beaulieu et al. 2005) insofar where flora is suffering from strong anthropogenic pressures. The human influence on the Mediterranean vegetation is antique (Pons and Quézel 1985), which result in fragmentation of habitat, disappearance of species and populations (Grenon and Batisse 1989; Ramade 1990; Heywood 1995).

Algeria has an important richness of Mediterranean flora and fauna. Basing on Quézel and Santa's flora (1962; 1963), Zeraia (1983) count 289 rare species, 647 rare, 675 very rare, 35 extremely rare, where 1611 rare species, which represent approximately more than half of the National Algerian flora.

These rare species were the object of several privileged studies. They have a considerable value in term of preservation too, either for patrimonial reasons, or for their great risk of extinction (Pimm et al. 1988; Gaston 1994). In this context, we select *Aristolochia baetica* L. among the endemic species in Algeria (Maire 1961*)*. This species is rather common one according to Quézel and Santa (1962, 1963). *A. baetica* is known by the vernacular name *Bereztem* (Bellakhdar 1997; Bammi and Douira 2004), and belonging to the Aristolochiaceae family (Heywood 1995). *A. baetica* L. is a climbing plant, perennial, characterized by persistent foliage and a long period of flowering extending from winter until spring (Berjano et al. 2011). *A. baetica* was used in phytotherapy in the whole world as anti-poison and a childbirth facilitator by stimulating uterine contractions (Bellakhdar 1997). The roots were used in case of bites of snakes and scorpion stings as antidotes. Furthermore, it was used to treat malaria, abdominal pains as anti-helminths and anti-worm causing their expulsion outside (Heinrich et al. 2009). The methanol extract of *A. baetica* is used as insecticide against *Tribolium castaneum* (Herbst) (Coleoptera: Tenebrionidae) (Jbilou et al. 2006). *A. baetica* is a Mediterranean species represented by a reduced number of localized populations and low numbers (Schemske et al. 1994; Colas 1997), which was found at the level of our study site where this species is seldom found. Those characteristics make this species an appropriate model primarily to study the lines of life history of the species growing in small populations, and to appreciate the issues of preservation of rare species. These two problematics are associated by combining an ecological approach, which is uncommon in most studies concerned by preservation of rare species.

The purpose of the current study consists on characterization of the habitat of *A. baetica* in Tessala Mount (north-west of Algeria), through the description of its edaphic substrate and floristic association.

MATERIALS AND METHODS

Study area

Our study site is located at the level of Tessala Mount, limited by the mounts of Berkèche on the west and on south by the plain of Sidi-Bel-Abbes, Algeria. This area is oriented by the southwest to northeast, characterized by summits with average heights of 600 m; the highest point rises to 1061m of height (Bouzidi et al. 2009; Saidi et al. 2016). The study area is characterized by a Mediterranean climate semi-arid with fresh winter. The annual average pluviometry is 335.16 mm and maximum average temperatures of 26.3°C in August and a minimum of 9.5°C in January (Cherifi et al. 2017) (Figure 1).

Procedures

Vegetation analysis

The various floristic reviews conducted at the level of the study area, allowed to select eight sampling stations (St1-St8) according to the presence of *A. baetica* as shown in Figure 1, where GPS coordinates are represented in Table 1. Aiming to characterize the species habitat, we examined the floristic and edaphic substrate of each station. For the analysis of the vegetation, 24 floristic reviews were performed on all stations, with an average of 3 reviews per station. These floristic reviews constituted qualitative and quantitative inventories of the vegetation using Braun-Blanquet (1951) method. For each surface statement with 25 m² (5m x 5m), were recorded the geographical localization, the height, the exposure, the slope as well as the present species by strata (tree layer - shrub layer - shrubby and herbaceous layer), affected by abundance-dominance coefficients (Coefficient 5: species covering more than 3/4 of the area; Coefficient 4: 3/4 to 1/2 of the area, Coefficient 3: 1/2 to 1/4 of the area; Coefficient 2: abundant species but covering - 1/4 of the area; Coefficient 1: species represented but covering - 1/20 of the area; Coefficient +: Present but not quantifiable species), sociability (1: isolated individuals; 2: individuals in small groups; 3: individuals in vast groups; 4: individuals in small colonies; 5: individuals in vast and dense populations) and their frequency of occurrence (F) (Class I: F= - 20% , very rare species; Class II: 40%>F>20%, rare species; Class III: 60%>F>40%, frequent species; Class IV: 80%>F>60%, abundant species; Class V: F> 80%, Constant species) in the various conducted floristic reviews. The inventoried species were classified according to their taxonomic families too (Quézel and Santa 1962-1963), biological spectrum (Raunkiaer 1934; Ellenberg and Mueller 1968), and biogeographical spectrum (Quézel and Santa 1962-1963; Ozenda 1985; Bonnier 1990).

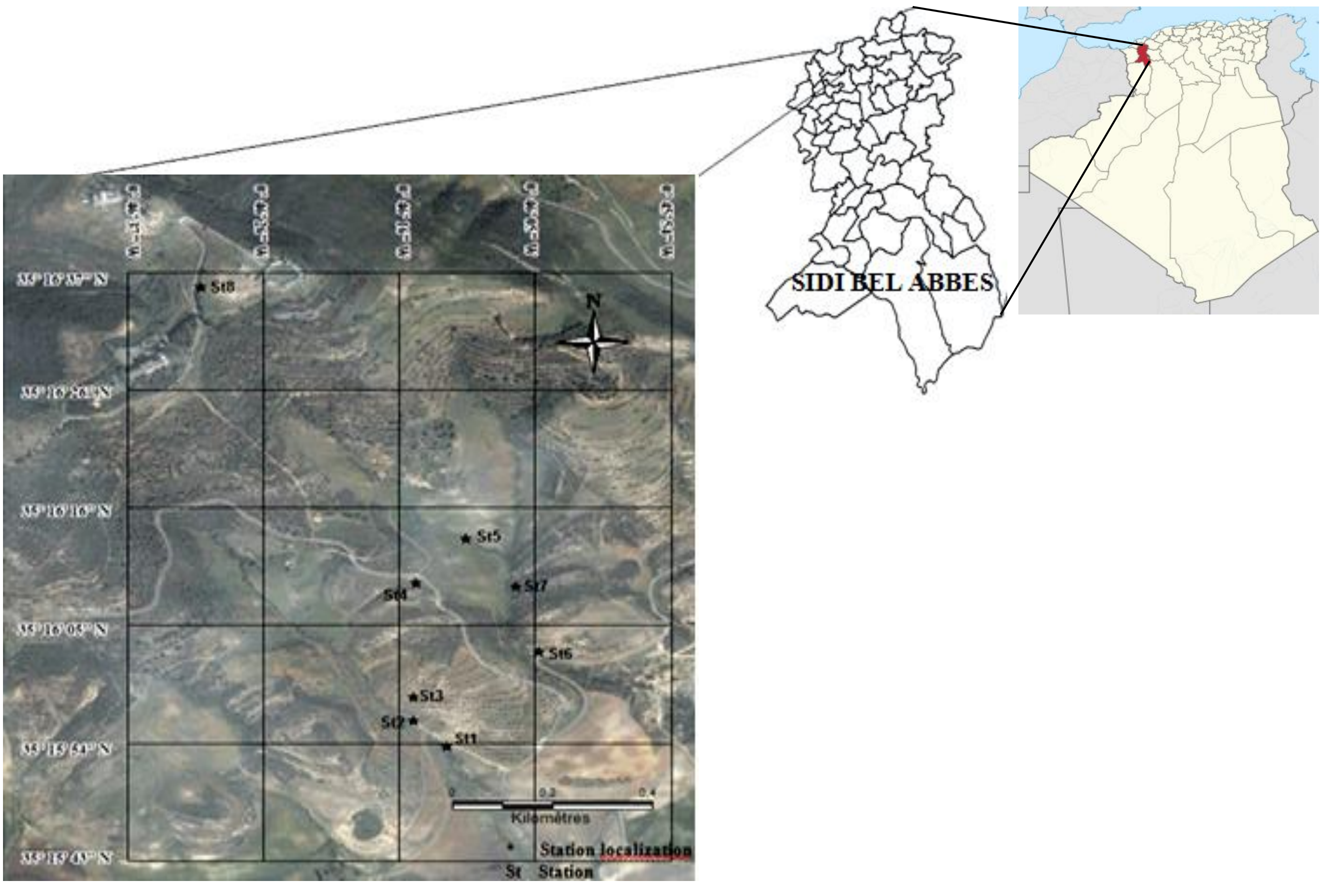


Figure 1. Positioning sampled stations in in Tessala Mount, Western Algeria (prepared by the MapInfo Professional ver. 8.0)

Table 1. Floristic surveys

Stations	**St1**			**St2**			**St3**			**St4**			**St5**			**St6**			**St7**			**St8**			
Exposure	SW			SW			SW			S			SE			SE			SE			NW			
Longitude	- 0°46’12’’			- 0°46’15’’			- 0°46’15’’			- 0°46’15’’			- 0°46’10’’			- 0°46’04’’			- 0°46’06’’			- 0°46’31’’			
Latitude	35°15’54’’			35°15’56’’			35°15’59’’			35°16’09’’			35°16’13’’			35°16’02’’			35°16’08’’			35°16’35’’			
Altitude (m)	726			728			771			800			750			747			680			935			
Slope (%)	25			12			25			12			12			10			60			50			
	Floristic surveys																								
	FS1	**FS2**	**FS3**	**FS4**	**FS5**	**FS6**	**FS7**	**FS8**	**FS9**	**FS10**	**FS11**	**FS12**	**FS13**	**FS14**	**FS15**	**FS16**	**FS17**	**FS18**	**FS19**	**FS20**	**FS21**	**FS22**	**FS23**	**FS24**	**F (%)**
Treelayer																									
Ficus carica L.	-	-	-	-	1.2	2.2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	8.33
Nerium oleander L.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1.1	-	-	-	-	-	4.16
Olea europea L.	-	-	-	1.1	-	1.1	-	-	-	-	-	-	3.3	4.3	4.3	-	-	-	1.2	1.2	1.2	-	-	-	33.30
Pinus halepensis L.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1.2	1.2	1.2	-	-	-	12.50
Pistacia terebinthus L.	-	-	-	1.1	1.1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	08.33
Quercus coccifera L.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3.3	4.3	4.3	12.50
Quercus ilex L.	-	-	-	-	-	-	-	-	-	-	-	-	4.3	3.3	3.3	-	-	-	-	-	-	4.3	3.3	3.3	25.00
Shrublayer																									
Olea europea var. oleaster L.	-	1.1	-	-	-	-	-	-	-	-	1.2	-	-	-	-	-	-	-	-	-	-	-	-	-	08.33
Shrubby and herbaceous layer																									
Ajuga iva (L) Schreb	-	1.1	1.1	-	-	-	-	-	-	-	-	-	-	-	-	1.2	1.2	-	-	-	-	-	-	-	16.70
Allium roseum L.	-	-	-	-	-	-	-	-	-	-	-	-	1.2	-	1.2	-	-	-	-	-	-	-	-	-	08.33
Ammi visnaga L.	-	2.1	1.1	-	-	-	-	-	-	-	-	-	1.2	1.2	-	-	-	-	1.2	-	-	-	-	-	20.80
Ampelodesmos mauritanicus Bir.	1.1	1.1	1.1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	12.50
Anacyclus clavatus (Desf.) Pers.	-	-	-	-	-	-	-	-	-	-	-	-	-	1.1	-	-	-	-	-	-	-	1.1	1.1	-	12.50
Anagallis monelli L.	-	-	-	-	-	-	-	-	-	-	-	-	1.1	1.1	1.1	-	-	-	-	-	-	1.1	1.1	1.1	25.00
Aristolochia baetica L.	3.3	3.3	2.3	3.2	2.3	2.3	1.2	2.2	1.2	1.2	1.2	1.2	3.2	2.2	3.2	2.2	1.2	1.2	1.1	1.1	2.1	2.2	1.2	1.2	100.00
Asparagus acutifolius L.	2.2	2.2	1.2	3.2	3.2	3.2	-	-	-	1.1	1.1	1.2	1.2	1.2	1.2	1.2	1.2	2.2	-	-	-	1.1	1.1	1.1	75.00
Asparagus albus L.	+	1.1	-	-	-	-	-	-	-	-	-	-	1.2	1.1	-	-	-	-	-	-	-	-	-	-	16.70
Asphodelus microcarpus Salzm et Viv.	1.1	1.2	1.2	2.2	2.2	1.2	-	1.1	1.1	1.2	2.2	-	1.2	1.2	1.2	-	1.2	1.2	1.1	-	-	1.1	1.1	1.1	79.20
Asteriscus maritimus L.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1.1	-	-	-	-	-	-	-	04.16
Avena sterilis L.	-	-	1.1	1.1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	8.33
Ballota hirsuta Benth	1.1	-	1.2	-	-	-	1.2	-	-	2.2	1.2	-	1.2	-	1.2	-	-	-	1.2	1.2	-	-	-	1.1	41.70
Bellis annua L.	-	-	-	-	-	-	-	-	-	-	-	-	1.1	1.1	1.1	-	-	-	-	-	-	-	-	-	12.50
Bromus rubens L.	-	-	-	1.1	-	1.1	-	-	-	-	-	-	1.2	1.2	-	1.1	-	1.1	-	-	-	1.1	1.1	-	33.30
Bromus lanceolatus Roth	1.2	1.1	1.2	-	-	-	1.1	-	1.1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	20.80
Calendula arvensis L.	-	-	-	-	-	-	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	-	-	-	-	-	-	1.1	1.1	1.1	50.00
Calycotome spinosa L.	2.3	3.3	3.3	2.2	2.2	2.2	3.3	3.3	3.3	3.2	2.2	2.2	1.2	1.2	1.2	2.3	3.3	2.3	2.2	2.2	1.2	1.1	1.1	1.1	100.00
Carduus pycnocephalus L.	-	-	-	-	-	-	-	-	-	1.1	1.1	-	-	-	-	-	-	-	-	1.2	-	-	-	-	12.50
Centaurea acaulis L.	-	-	-	1.1	1.1	1.1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	12.50
Centaurea pullata L.	-	-	-	-	-	-	-	-	-	-	-	-	1.1	1.1	-	-	-	-	-	-	-	1.1	1.1	-	16.70

Chamaerops humilis L.	3.3	2.3	3.3	2.2	2.2	1.2	3.3	3.3	3.3	2.2	2.2	2.2	2.2	1.2	2.2	3.3	2.3	2.3	4.3	3.3	3.3	1.1	1.1	2.1	100.00
Convolvulus althaeoides L.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	+.+	-	-	-	1.1	1.1	1.1	-	-	1.1	20.80
Daphne gnidium L.	-	-	-	1.2	2.2	1.2	1.2	-	1.2	2.2	2.1	-	1.1	1.1	1.1	-	-	-	2.2	1.2	-	1.1	1.1	1.1	62.50
Daucus carota L.	-	-	-	-	-	-	1.1	1.1	-	1.1	1.1	1.1	-	-	-	-	-	-	-	-	-	-	-	-	20.80
Eruca vesicaria L.	-	-	-	-	-	-	-	-	-	-	-	-	1.2	1.2	-	-	-	-	-	-	-	1.1	1.1	-	16.70
Evax pygmaea Pers	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	04.16
Foeniculum vulgare Mill.	-	-	-	-	-	-	-	-	-	-	-	-	1.1	-	-	-	-	-	-	-	-	1.1	-	-	08.33
Hedera helix L.	1.1	1.1	1.1	-	-	-	1.1	1.1	1.1	-	-	1.1	-	-	-	-	-	-	-	-	-	-	-	-	29.20
Helianthemum appeninum L.	-	-	-	-	-	-	-	-	-	-	-	-	1.2	-	1.2	-	-	-	-	-	-	1.1	-	-	12.50
Iris xiphium L.	-	-	-	-	-	-	-	-	-	+	1.1	-	-	-	-	-	-	-	-	-	-	-	-	-	08.33
Lobularia maritima L.	1.1	1.1	-	-	-	-	1.1	1.1	-	1.1	1.1	1.2	-	-	-	1.1	-	1.1	-	-	-	-	-	-	37.50
Malva sylvestris L.	-	-	-	-	-	-	1.1	1.1	-	1.2	-	-	-	-	-	+	+	+	-	-	-	-	-	-	25.00
Marrubium vulgare L.	-	-	-	1.1	1.1	1.1	-	1.1	1.2	-	-	-	2.2	1.2	1.2	-	-	-	-	-	-	-	1.2	1.2	41.70
Ornithogalum umbellatum L.	-	-	-	-	-	-	-	-	-	1.1	-	-	-	-	-	1.2	1.2	1.2	-	-	-	-	-	-	16.70
Oxalis corniculata L.	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	04.16
Papaver rhoeas L.	-	-	-	-	-	-	-	-	-	-	-	1.2	-	-	-	-	-	-	-	1.2	1.2	-	-	-	12.50
Paronychia argentea Lam.	-	-	-	-	-	-	-	-	-	1.1	1.1	1.1	1.2	-	-	-	1.1	1.1	-	-	-	1.1	-	-	29.20
Pistacia lentiscus L.	-	-	-	-	-	-	-	-	-	-	-	-	1.1	-	-	-	-	-	-	-	-	1.2	-	-	08.33
Plantago albicans L.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1.2	-	1.2	-	-	-	08.33
Plantago lagopus L.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1.1	1.1	1.1	-	-	-	-	-	-	12.50
Ranunculus arvensis L.	-	-	-	-	-	-	-	-	-	1.1	-	-	-	-	-	-	-	-	-	1.2	1.2	-	-	-	12.50
Raphanus raphanistrum L.	-	-	-	-	-	-	-	-	-	-	-	-	-	1.1	1.1	-	-	-	-	-	-	-	1.1	1.1	16.70
Reseda alba L.	-	-	-	-	-	-	-	-	-	-	-	-	1.2	1.2	1.2	-	-	-	1.1	1.1	-	1.1	1.1	1.1	33.30
Rosmarinus officinalis L.	-	1.2	1.1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	08.33
Rumex bucephalophorus L.	-	-	-	-	-	-	+	-	-	1.1	1.2	1.2	-	-	-	1.1	1.1	1.1	-	-	-	-	-	-	29.20
Ruta chalepensis L.	-	-	-	-	-	-	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	-	-	-	-	-	-	-	1.2	1.2	-	41.70
Ruta montana (Clus.) L.	1.2	1.2	-	1.1	1.1	1.1	-	-	-	1.1	1.1	1.1	1.1	1.1	1.1	-	-	-	1.1	-	1.1	1.2	1.2	1.2	66.70
Salvia argentea L.	-	-	-	-	-	-	+	-	-	1.1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	08.33
Salvia officinalis L.	-	-	-	-	-	-	-	-	-	-	-	-	1.1	1.1	1.1	-	-	-	-	-	-	-	-	-	12.50
Scolymus hispanicus L.	-	-	-	-	-	-	-	-	-	1.1	1.1	-	1.1	1.1	1.1	-	-	-	-	-	-	-	-	-	20.80
Scolymus sp.	-	-	-	1.1	1.1	1.1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	12.50
Silene colorata Poiret.	-	-	-	-	-	-	-	-	-	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	04.16
Silybum marianum L.	-	1.1	1.1	1.1	1.1	-	1.2	1.2	1.2	-	-	-	-	-	-	-	-	-	1.1	1.1	1.1	1.1	-	1.1	50.00
Sisymbrium officinale L.	-	-	-	-	-	-	-	-	-	1.1	1.2	1.2	-	-	-	-	-	-	1.1	-	1.1	-	-	-	20.80
Stipa tenacissima L.	-	-	-	-	-	-	+	-	-	+	+	-	-	-	1.1	1.1	1.1	-	-	-	-	+	-	-	29.20
Teucrium polium L.	1.2	1.2	1.1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	+	-	-	-	-	-	-	16.70
Thymus ciliatus Desf.	-	-	-	-	-	-	-	-	-	1.1	1.1	-	1.2	-	-	-	-	-	-	-	-	1.1	-	-	16.70
Torilis nodosa L.	-	-	-	-	-	-	-	-	-	-	1.1	1.1	-	-	-	-	-	-	-	-	-	-	-	-	08.33
Trifolium stellatum L.	-	1.1	1.1	-	-	-	-	-	-	1.1	1.1	1.1	-	-	-	-	-	-	1.1	1.1	-	-	-	-	29.20
Urginea maritima (L.) Baker.	1.2	1.1	1.2	1.1	1.1	1.1	1.1	-	1.1	1.2	-	1.2	1.2	1.2	1.2	1.2	1.2	-	-	-	-	1.2	1.2	1.2	75.00
Number of species by survey	15	19	17	16	14	14	17	12	12	28	23	18	30	25	23	14	15	14	17	14	12	25	20	18	/
Number of species by station	23			17			19			31			34			17			20			29			/
Total number of species	68																								

Note: St: Station; FS: Floristic surveys; SW: South-West; S: South; SE: South-East; NW: North-West; F: frequency of occurrence

Soil analysis

Concerning soil analysis, three samples were taken from each station of the topsoil to a depth from 10 to 20 cm. Soil samples were then dried in the open air for 15 days. Once dried, we analyzed the following parameters: pH (the principle consists in measuring the electromotive force of an aqueous solution of the soil (water/soil ratio) using a pH meter); organic matter content (the carbon of the organic matter is oxidized by bichromate of potassium in the presence of sulfuric acid. Knowing the amount of bichromate necessary for this oxidation, the percentage of organic carbon and humus in the soil was calculated using this formula: % humus /% COx = 1.724 (Baize 1988);

The texture of soil revealed by its granulometric analysis whose principle is based on the rate of sedimentation of particles separated and dispersed by destruction of their cement (limestone and organic matter). The fractionation of these particles took place via the Robinson pipette, which allows the determination of clay and silt fractions (Baize 1988). These results were reported according to the percentages of clays, silts, and sands in the textural triangle, to determine the texture. The electrical conductivity was measured with a conductimeter as a function of the concentration of electrolytes in a 1/5 aqueous extraction solution (Richards 1954). The cationic and anionic compositions of the soil extract were carried out according to the method described by Jackson (1962). The total limestone ($CaCO_3$) measure that is based on the characterized reaction of carbonate of calcium (CaCO3) with hydrochloric acid (HCl) was carried out with the calcimeter of Bernard (Baize 1988). The active limestone was carried out with a specific reagent (ammonium oxalate), which only attacks a fraction of the total limestone. The extracted calcium was then dosed (Baize 1988). The analytical methods used were those set by Aubert in its manual soil testing (1978).

Data analysis

Plant and soil data were assessed through correspondence factor analysis (CFA), a suitable approach to phytoecological studies, since it allows to treat jointly floristic variables and soil variables (Djebaili 1984; Cherifi et al. 2011; Bouterfas et al. 2013). Moreover, CFA was used to bring out the floristic cortege of *A. baetica*, as well as the characteristics of the substrate on which it evolved. In addition to the CFA, we used the hierarchical ascending classification (HAC) to better individualize the limits between the different groups (Benzécri 1984; Cherifi et al. 2014, 2017). These two techniques indicated the degree of similarity (homogeneity) or disparity (diversity) of the species composition in the different investigated stations (Pearson 1982).

RESULTS AND DISCUSSION

Vegetation analysis

Table 1 summarizes the floristic reviews conducted at the sampling stations. The floristic inventory allowed us to identify 68 species making part of floristic cortege of *A. baetica*. The floristic composition presented in Table 1 revealed a heterogeneous diversity between 17 species (St2 and St6) and 34 species (St5). This heterogeneity reflects the influence of different environmental parameters and even anthropogenic action on the vegetation distribution. The assessment of the frequency of occurrence of the inventoried species on all floristic surveys revealed the presence of very rare species (52.94%), rare (26.47%), common (8.82%), abundant (7.35%), and constants species (4.42%) as illustrated in Figure 2.

Among the common species which are associated with *A. baetica* in most surveys, we have *Calycotome spinosa*, *Chamaerops humilis*, *Urginea maritima*, *Asparagus acutifolius*, and *Asphodelus microcarpus* that constitutes its floristic cortege.

Families' characterization

The inventoried species belong to 31 botanical families (Figure 3). Asteraceae represent the highest rate in St2 (17.65%); St5 (14.7%); St7 (10%) and St8 (13.79%). Afterward come Lamiaceae in St1 (17.39%); St3 (15.79%); St4 (12.5%), and St6 (16.67%), then Liliaceae in St6 (16.67%), and Poaceae in St1 (13.05%). The other families are poorly represented. Generally, Asteraceae and Lamiaceae represented the most dominant families in the 8 stations, with rates of 15.95% and 13.04% respectively.

Biological spectrum of identified species

Analysis of the biological spectrum of the inventoried species on all stations is represented on Figure 4. Species belonging to the floristic cortege of *A. baetica* were represented mainly by therophytes and hemicryptophytes. The therophytes were represented essentially at St7 with a rate of 35%. The hemicryptophytes dominated in St3 with a maximum of 31.58%. Then come the chamaephytes with a maximum rate of 26.08% in St1. In the fourth position come the geophytes with a maximum rate of 22.22% in St6. The phanerophytes and nanophanérophytes were

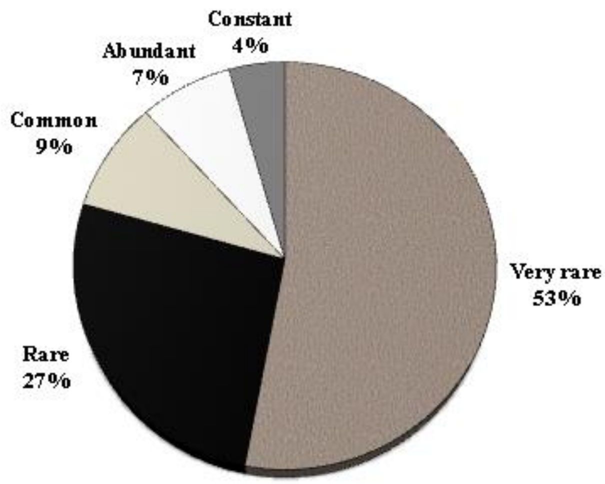


Figure 2. Distribution of species inventoried according to their frequency of occurrence

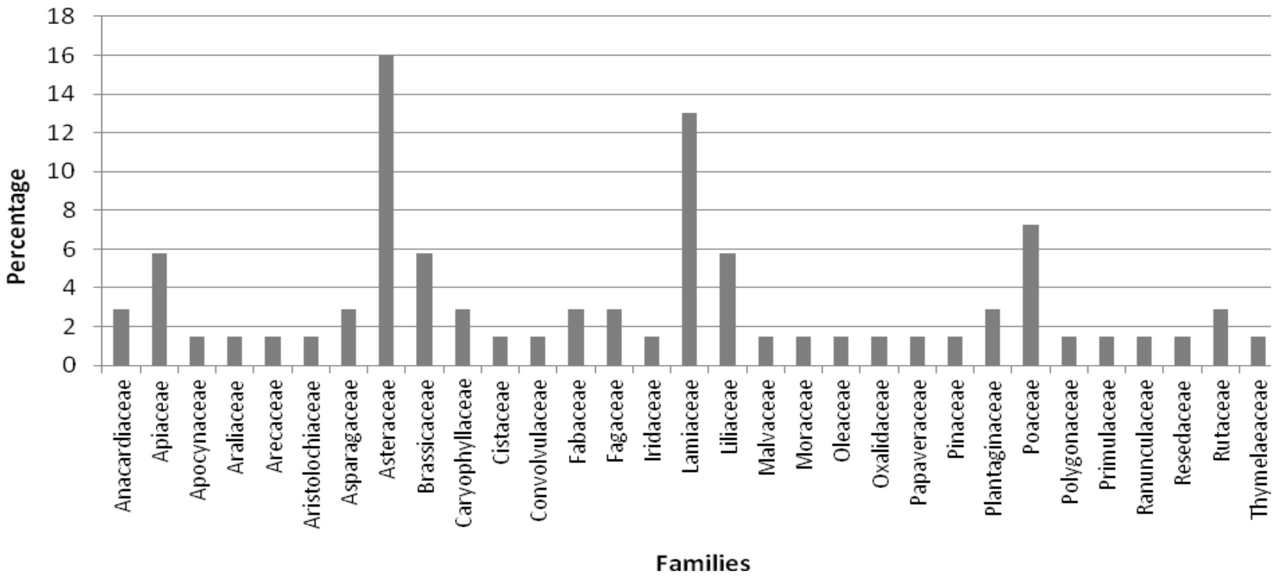
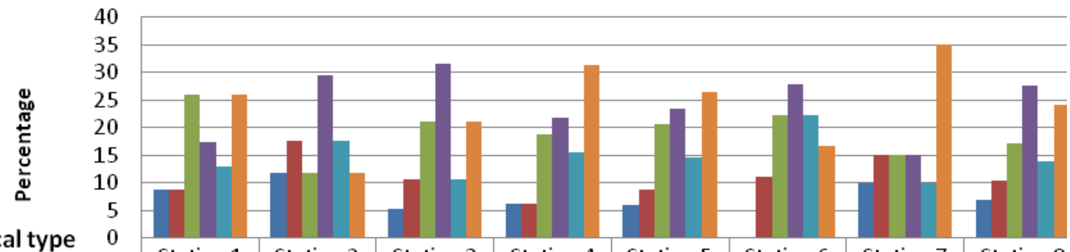


Figure 3. Distribution of the percentage of botanical families



Biological type	Station 1	Station 2	Station 3	Station 4	Station 5	Station 6	Station 7	Station 8
Phanerophytes	8,7	11,76	5,26	6,25	5,88	0	10	6,9
Nanophanerophytes	8,7	17,65	10,53	6,25	8,82	11,11	15	10,34
Chaméphytes	26,08	11,76	21,05	18,75	20,59	22,22	15	17,24
Hemicryptophytes	17,4	29,42	31,58	21,87	23,53	27,78	15	27,59
Geophytes	13,04	17,65	10,53	15,63	14,71	22,22	10	13,79
Therophytes	26,08	11,76	21,05	31,25	26,47	16,67	35	24,14

Figure 4. Biological spectrum of species inventoried

poorly represented. The analysis of the biological spectrum of all the inventoried species on the 8 stations indicated the predominance of therophytes (33.34%) and the hemicryptophytes (24.63%). The therophytisation is a result of unfavorable weather conditions, particularly drought and anthropogenic pressure (Benaradj et al., 2015; Mostefai et al. 2015, 216; Saidi et al. 2016; Chalane et al. 2017; Cherif et al. 2017), and edaphic conditions. The abundance of hemicryptophytes is explained by the richness of organic matter and altitude which is the case in our study area (Cherifi et al. 2011, 2014, 2017).

Biogeographical type

Analysis of the biogeographic type showed the dominance of Mediterranean type species which represented almost half of the recorded species (34 species) with a rate of 49.27%, followed by Eurasian type species (7 species with a rate of 10.13%). The other types, despite their low participation, contribute to the diversity and richness of plant genetic potential of the studied area (Figure 5). More than 15 biogeographical types were observed, which indicated a high phytodiversity in the studied area. The dominance of the Mediterranean element was confirmed in Mount of Tessala in some work on the assessment of plant diversity (Cherifi et al. 2011; Bouterfas et al. 2013; Cherifi et al. 2014; Bouzidi et al. 2012; Benchiha et al. 2014) and in several regions of western Algeria as north of Tlemcen (Ghezlaoui et al. 2009; Belhacini and Bouazza 2012; Hachemi et al. 2012).

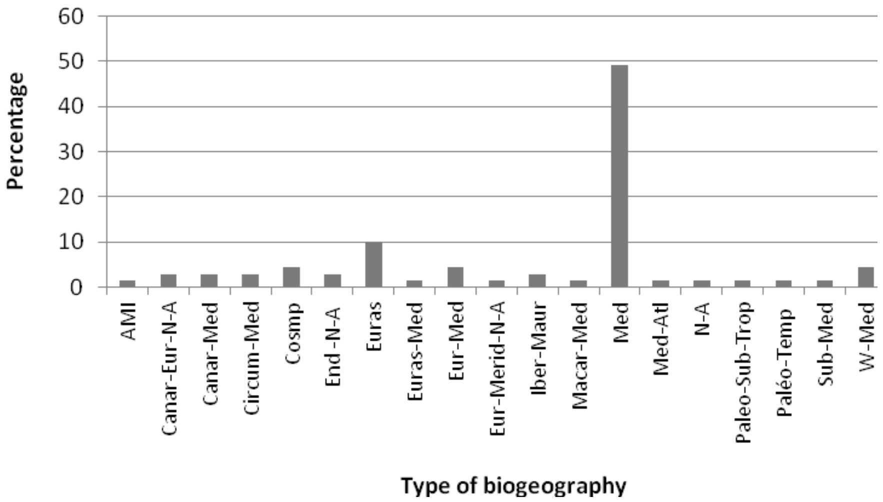


Figure 5. Biogeographical spectrum of species inventoried. AMI: Algéria, Morocco and Iberian-Peninsula; Canar-Eur-N-A: Canarien-Europeen-North-African; Canar-Med: Canarian-Mediterranean; Cosmp: Cosmopolitan; End-N-A: Endemic North African; End-Alg-Tun: Endemic Algeria-Tunisia; Euras: Eurasian; Euras-Med: Eurasian-Mediterranean; Eur-Merid-N-A: Southern Europe-North African; Iber-Maur: Ibero-Mauretanien; Macar-Med: Macaronésien-Mediterranean; Med: Mediterranean; Med-Atl: Atlantic Mediterranean; N-A: North African; Paleo-Sub-Trop: Paléo-Sub-Tropical; Paléo-Temp: paleo-Temperate; Sub-Med: sub-mediterranean; W-Med: West Mediterranean.

Table 2. Soil analysis

Stations	St1	St2	St3	St4	St5	St6	St7	St8
pH	7.37	7.48	7.74	7.87	7.38	7.96	7.72	7.65
OM (%)	4.20	6.20	7.44	7.54	4.40	0.50	6.35	6.65
Sand (%)	40	45	45	40	50	38	43	40
Limon (%)	40	20	30	35	27	30	37	35
Clay (%)	20	35	25	25	23	32	20	25
Al (%)	3.00	1.88	2.38	5.38	2.00	3.75	5.50	2.87
Tl (%)	20.00	17.62	6.00	18.80	5.20	12.00	34.80	6.40
Co (ms/cm)	0.15	0.08	0.09	0.13	0.09	0.14	0.13	0.07

Note: OM: organic matter; Al: Active limestone; Tl: Total limestone; Co: conductivity

Soil analysis

The physicochemical analysis results of soil samples taken from each experimental site are summarized in table 2. We observed that *A. baetica* grew in different textures (silty texture: St1, St4, St7, and St8; sandy clay loam texture: St3 and St5; clay loam texture: St6 and sandy clay texture: St2). The pH, in the majority of samples, varied between 7.96 and 7.37. However, the electrical conductivity was low and did not exceed 0.6 ms/cm, which indicated that our soil was slightly alkaline and unsalted. These two parameters depend on the nature of the vegetation and climatic conditions (Dajoz 1982). Furthermore, pH is related to the quantity of calcium present in the soil and depends on the clay-humus complex too (Arshad & Cohen 1992). The rate of soluble salts in the soil depends on depth, texture, evapotranspiration, and profile moisture (Bendaanoun 1981; Bouterfas 2015). The pH value determines the physical behavior of the soil (structural stability, resistance to crusting, etc.), its chemical behavior (Operating CEC, availability of phosphorus, bioavailability of trace elements and microelements, etc.) and its biological behavior (humification and mineralization of organic matter).

The total limestone rate varied between 5.20% and 34.80% and the active between 1.88% and 2.87%. The presence of limestone gives soil the specific characteristics in terms of physical and chemical behavior, and even affect its biological activity. The calcium content is related to the nature of the rock and explains the scrubland of installation in our study area resulting from the degradation of forest formations (Benabdeli 1983).

The soil, in almost all stations, was rich in organic matter. This organic matter plays an important role in physical, chemical, and biological functioning of soil by improving the cohesion of the structural elements, promoting useful water retention, participating in the reversible storage of nutritional elements, and increasing soil aeration. It should be noticed that the quantity of the organic matter varies according to the diversity and species richness of vegetation cover, climatic conditions, and the nature of the substrate (Duchaufour 2001).

Aristolochia baetica can grow on any soil at an altitude which can range from 0 to 1800 m, in well-watered areas or semi-arid (Maire 1961). This species, observed in woodlands, bushes or rocks *(*Maire 1961), can be encountered in Africa as in Iberia, and in the southwestern tip of Europe. All these characteristics are fairly extensive and represent a broad spectrum.

According to our results, it appears that *A. baetica* grows on light soils, essentially silty-sandy texture, with a high limestone content that allows us to classify the species as calcicole, rich in organic matter, and slightly alkaline pH.

Relationship between the floristics characteristics and soil parameters

The CFA, performed on all the floristic characteristics and soil parameters of the sampling stations, is shown in Figure 6. In this analysis, plane F1 / F2, that has been retained, provides the most information on the correlations between the studied species, floristic composition, and soil parameters on which it develops. Axis F1 providing the most important statistical information in the CFA, with 30.65% of inertia ratio, shows the existence of three groups: (i) Group 1 (Gr 1): represented by St1, St2, St3, St4, and St6 which dominated *A. baetica* (Ar ba) with its floristic cortege consisting essentially of: *Asparagus acutifolius* (As ac), *Asparagus albus* (As al), *Asphodelus microcarpus* (As mi), *Ballota hirsuta* (Ba hi), *Calycotome spinosa* (Ca sp), C*hamaeros humilis* L. (Ch hu), *Daphne gnidium* (Da gn), *Urginea maritima* (Ur ma). This species group is linked to a type of limestone substrate (Lt). The raised stations are represented by scrubland, in the south, with a highly calcareous soil, which promotes the installation of these stands reflecting a deterioration whose origin is the anthropogenic effect exerted by man and his flock on the one hand and the climate hostility on the other hand (Cherifi et al. 2011, 2014); (ii) Group 2 (Gr 2): represented by the matorals based on a *Quercus ilex* in St5 and St8 dominated with the following species: *Ampelodesmos mauritanicus* (Am ma), *Anagallis collina* (An co), *Olea europea* (Ol eu), *Salvia officinalis* (Sa of), correlated with the altitude factor (Alt), and a substrate rich in organic matter (OM), reflecting a high density of these plant formations; (iii) Group 3 (Gr 3): represented by a forest (St7) based on a *Pinus halepensis* (Pi ha) with domination of the following species: *Ammi visnaga* (Am vi), *Papaver rhoeas* (Pa rh), *Plantago albicans* (Pl al), *Rosmarinus officinalis* (Ro of), correlated with the altitude factor and a substrate rich in organic matter to slightly alkaline pH, and a high calcium levels with a steep slope.

HAC confirmed the three groups of stations identified by CFA (Figure 7). The HAC resulted in the categorization of the sampled stations into three main groups. This classification shows a great heterogeneity in the structuring of our study site, reflecting its diversity, which is essentially due to the different ecological conditions: soil, vegetation type, and stationary parameters.

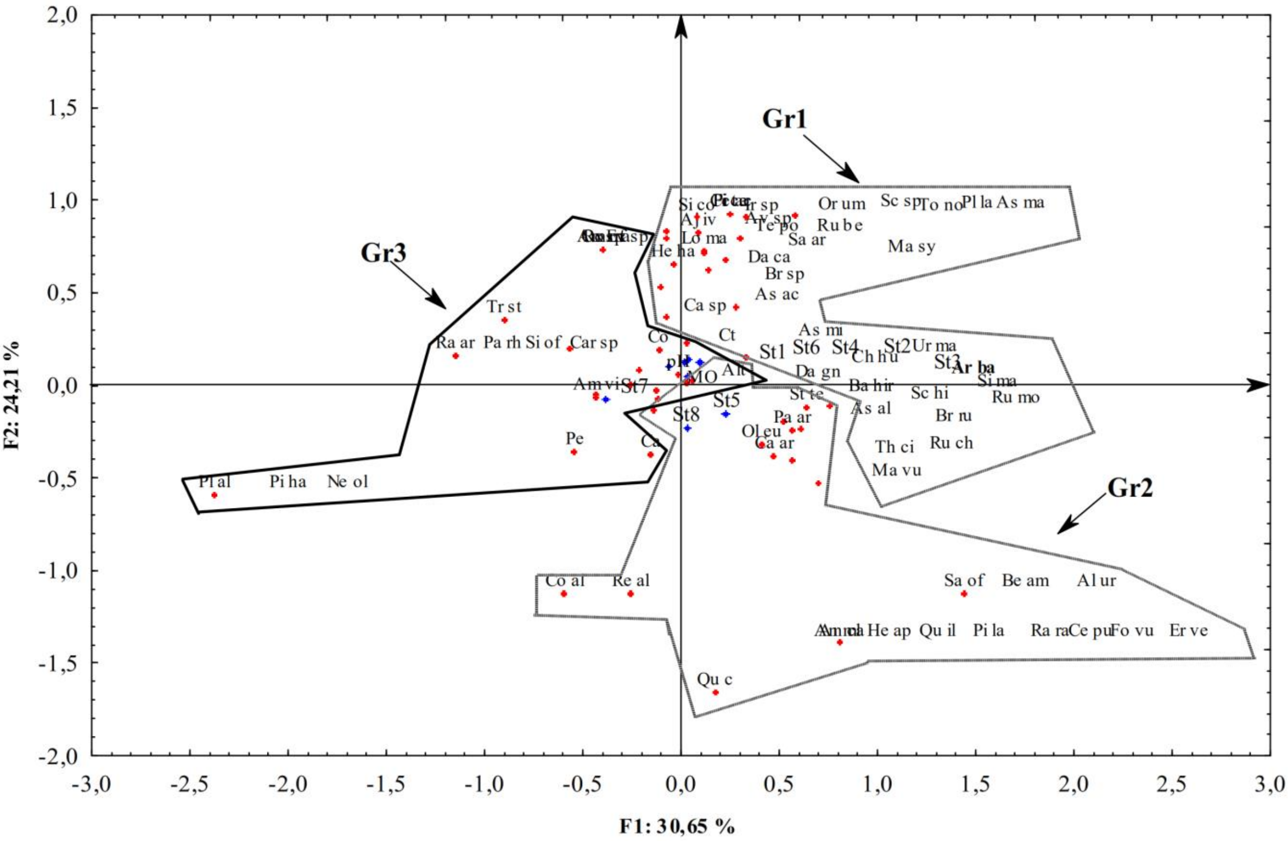


Figure 6. Representation of the correspondence factor analysis

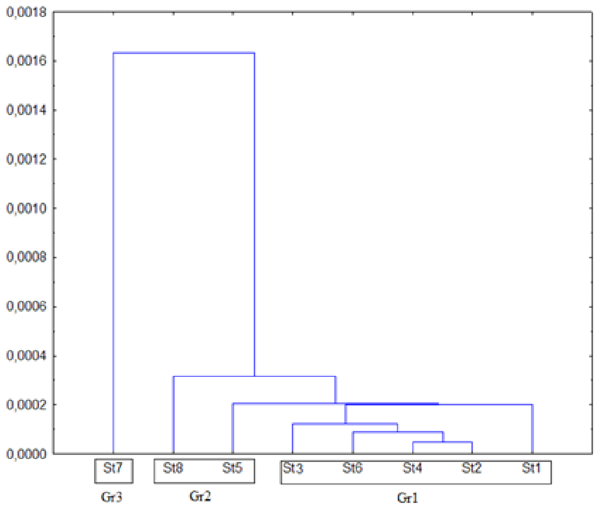


Figure 7. Representation of the hierarchical ascending classification

In conclusion, our findings permitted to characterize *A. baetica* in Tessala Mount (western Algeria) taking into account the physical and chemical factors of the soil at the level of the studied sites and it's floristic. The floristic inventory was represented by 68 species distributed in 31 families with dominance of Asteraceae and Lamiaceae, 6 biological types with dominance of therophytes, and 19 biogeographical types with dominance of Mediterranean element. The floristic data analysis and physicochemical parameters of soil performed through CFA and HAC, revealed that *A. baetica* is associated essentially with the degraded scrubland species, as: *Asphodelus microcarpus*, *Calycotome spinosa*, *Chamaerops humilis*, and *Urginea maritima*. Regarding edaphic parameters, *A. baetica* grows on calcareous soils, with essentially silty-sandy texture, unsalted with slightly alkaline pH. Some limitations of the study should be noticed. Further investigations are recommended by increasing the number of study stations. For that purpose, we plan for additional sampling in space and time to set other environmental parameters governing the habitat of *A. baetica*.

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