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PHYTOSOCIOLOGICAL ANALYSIS ON THE NATIONAL PARK OF THE TEK TEK MOUNTAINS, ŞANLIURFA, TURKEY

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Abstract

Vegetation of the national park of Tek Tek Mountains under the semi-arid and cool Mediterranean climate was analyzed according to 'Braun-Blanquet approach'. The plant associations are classified by considering the characteristic features of the species. In the national park, one new association (*Ceraso tortusae - Pistacietum palaestinae*) belonging to the shrub vegetation, and two new associations (*Achilleo aleppicae - Centaureetum virgatae* and *Eryngietum cretico – virentis*) belonging to steppe vegetation were determined. No similarity among these associations has been identified in the study area with any others introduced before was found. Therefore, these syntaxa are new for science.

Introduction

Southeast Anatolia region of Turkey consists the most indistinct and plain landforms. The topography approaches towards the Southeast Taurus Mountains, which compass the region from north as an arc, elevation increases and landforms become more wavy and hilly. The elevation of Southeast Anatolia plains decreases with a slight slope from the skirts of southeast Taurus Mountains towards the Syrian border. Towards their edges, these plains take the view of plateaus into which valleys are buried and towards middle parts, they look more like a low land.

Located on the southern edges of southeast Taurus Mountains, Harran plain is a graben - (~30 × 50 km). Tek Tek and Fatik mountains, located in the east and west of Harran plains, are horsts that extend in north-south direction. Tek Tek Mountains, located in a semi-arid region, are subjected to mentioned problems for example, weak vegetation formed as a result of precipitation and deficiency of water resources and usually look like a callow plateau although they have some higher points. These mountains also include a national park (Fig. 1).

In the arid and semi-arid regions, the interventions made by humans on the natural vegetation cause extreme reduction of climax species, dramatical deforestation and anthropogenic steppes becoming widespread and causing the area to appear as if they were the original vegetation of the area. For example, Tek Tek Mountains, while, through the long time most was covered by *Pictacia terebinthus* subsp. *palaestina*, they have presently left their places to the uncultivable scar rocky due to the soil erosion as a result of over-woodcutting and over-grazing. However, in the present day, this taxon is only encountered within the national park.

Materials and Methods

In identifying the plant species, basically Flora of Turkey (Davis 1965-1985, Davis *et al.* 1988, Güner *et al.* 2000), as well as some other floras (Zohary and Feinbrun-Dothan 1966-1986, Towsend and Guest 1966-1985) and other studies (Adıgüzel and Aytaç 2001, Kaya and Ertekin 2009) were consulted.

Phytosociological nomenclature of the defined syntaxa was performed according to Weber *et al.* (2000). Detailed scale of Frey and Lösch (1998) was used in order to determine the abundance-cover values of the species (r = 1 individual, also rare outside the relevé (=quadrat),

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small plant); + = 2 - 5 (small) individuals, cover < 5%; 1 = 6 - 50 individuals, cover < 5%; or few larger individuals (often given as 1 - 5) with a cover up to 5%; 1m = many individuals (> 50), cover < 5%; 2a = cover 5 - 12.4%; 2b = cover 12.5 - 25%; 3 = cover 25 - 50%; 4 = cover 50 - 75%; 5 = cover 75 - 100%).

Evaluation of floristic tables in terms of phytosociology was made by using Braun-Blanquet (1965) approach. Syntaxa belonging to shrub vegetation were classified depending on the studies of Braun-Blanquet *et al.* (1952), Mucina (1997), and Quézel *et al.* (1978); whereas, syntaxa belonging to steppe vegetation were classified depending on the studies of Quézel (1973), Akman *et al.* (1985) and Kaya and Ketenoğlu (2010). Tables belonging to associations were given together with the upper syntaxonomic units in which they were placed.

Soil samples were collected from the survey area so as to determine edaphic features of plant associations and were conducted according to Tüzüner (1990) at Soil, Fertilizer and Water Resources Central Research Institute. Climatic data for the study area were obtained from Directorate General of Meteorology (Anon. 2010). Ombrothermic climate (precipitation-temperature) diagram was drawn according to the Gaussen method (Bagnouls and Gaussen 1953).

Results and Discussion

The soil on Tek Tek Mountains which was disintegrated in the tropical conditions of Tertiary era was wiped away with the rains in Pluvial period resulted because of climatic changes in Pleistocene. The Harran basin is filled with this soil. The plateau surface was literally ripped up by rivers due to the increasing rainfall of Pleistocene. Surface of the plateau was disintegrated with multiple drought valleys, because the area is composed of thick limestone layers and the severe evaporation occurs during summer months (Güzel 1998).

Red-brown soil is seen in the study area. The land surface is covered by coarse gravel, rubble and stones. These soils are medium-deep, clayed, clayed-loamy and rocky and are found in semi-arid climates (Anon. 1995). According to Tüzüner (1990), the soils in study area are generally alkaline, saltless, highly limey and rich in phosphorus and potassium (Table 1).

Table 1. Physicochemical properties of the soils of the study area.

Association	Relevé no.	Texture	Saturation (%)	EC, dS/m	pH	$CaCO_3$ (%)	P_2O_5 (kg/da)	K_2O (kg/da)	Organic matter (%)	N (%)
Ceraso tortusae - Pistacietum palaestinae	1	CL	64	1.045	8	14.2	1.4	123.2	2.5	0.13
	2	C	77	1.040	7.8	4.9	6	157.9	2.8	0.14
	5	C	71	0.990	7.8	3.2	5.5	123.1	2.6	0.13
	8	C	76	1.055	7.9	1.9	1.1	138.1	2.7	0.14
Achilleo aleppicae - Centaureetum virgatae	14	CL	55	1.032	7.9	24.8	1.9	102.2	1.5	0.07
	18	CL	66	1.107	8	1.7	0.8	95.6	1.9	0.10
Eryngietum cretico - virentis	22	CL	62	1.057	7.7	1.5	0.7	92.3	1.3	0.07
	26	CL	53	1.063	7.8	1.2	1.5	91.7	1	0.04

Texture legend: C: clay, L: loamy, CL: clay-loamy.

The saturation percentage and the other relevant data of Table 1 reveals that *Ceraso tortusae - Pistacietum palaestinae* spreads usually on soil with loamy and rarely clay-loamy texture and other two associations (*Achilleo aleppicae - Centauretum virgatae* and *Eryngietum cretico - virenti*) spread on soil only with clay-loamy texture. The soil of all the three associations in the

area slightly alkaline in terms of pH and can be classified as saltless soil in terms of electrical conductivity (EC).

Most of the soil of Turkey is limy (Gedikoğlu 1990). In the present investigation, lime contents of the soil where associations spread show different from each other. *Ceraso tortusae - Pistacietum palaestinae* is found on limy and medium-limy soil, *Achilleo aleppicae - Centauretum virgatae* is found on limy and highly limy soil, and *Eryngietum cretico - virenti* is found on limy soil.

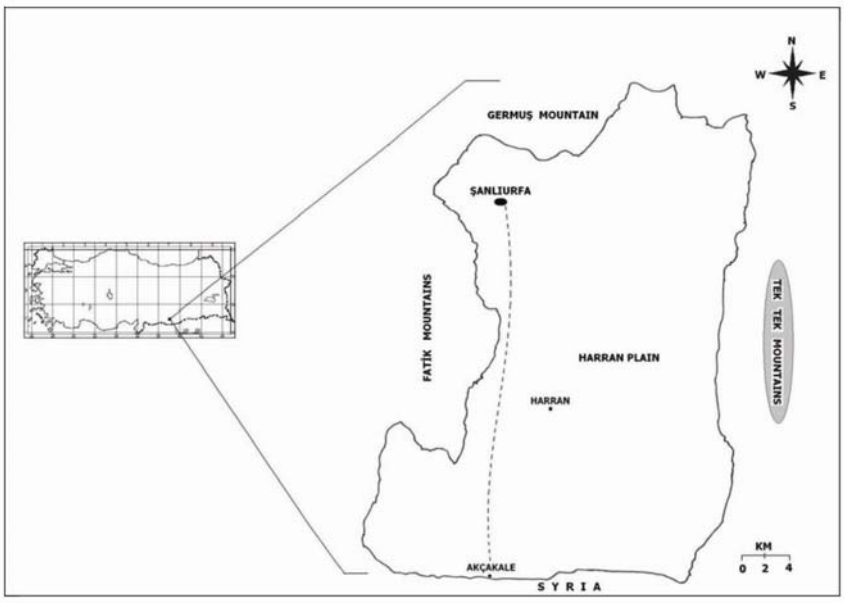

Fig. 1. Location of Tek Tek mountains in Şanlıurfa.

Soil phosphorus is lacking in majority part of Turkey (Eyüpoğlu 1999). In the present investigation, phosphorus ratio is usually lower in the soil of *Achilleo aleppicae - Centauretum virgatae* and *Eryngietum cretico - virenti*, whereas it relevés 1 and 5 of *Ceraso tortusae - Pistacietum palaestinae* phosphor in ratio is very low, in relevé 2 low and in relevé 8 high phosphor ratios are seen.

Potassium was variable in different coverages (Table 1) but it was high elsewhere throughout Turkey (Eyüpoğlu 1999). In terms of plant efficiency, there is no potassium supply shortage in the association areas. Turkish soil generally lacks organic matter (Eyüpoğlu 1999). In the present investigation, it has been seen that organic matter is low in *Achilleo aleppicae - Centauretum virgatae* and *Eryngietum cretico - virenti*, whereas it is medium in *Ceraso tortusae - Pistacietum palaestinae* (Table 1). The nitrogen content was detected to be very low only in relevé 14 of *Achilleo aleppicae - Centauretum virgatae*, whereas it was determined that usually amount of nitrogen is sufficient in other associations soils.

It was observed that the soil parameters obtained from the analysis were at optimal rate for the plant growth. It can be said that the vegetation of the national park depends on other biotic and abiotic factors rather than the soil.

According to the meteorological data of Şanlıurfa meteorology station (Anon. 2010), precipitation regime is in the form of W.Sp.A.Sm (winter, spring, autumn, summer) and eastern

Mediterranean type 1. In the study area, semi-arid and cool Mediterranean climate can be seen. In Şanlıurfa, the dry season takes six months from the late April - early May and to the early November, and precipitation season takes another six months from early November to early May (Fig. 2).

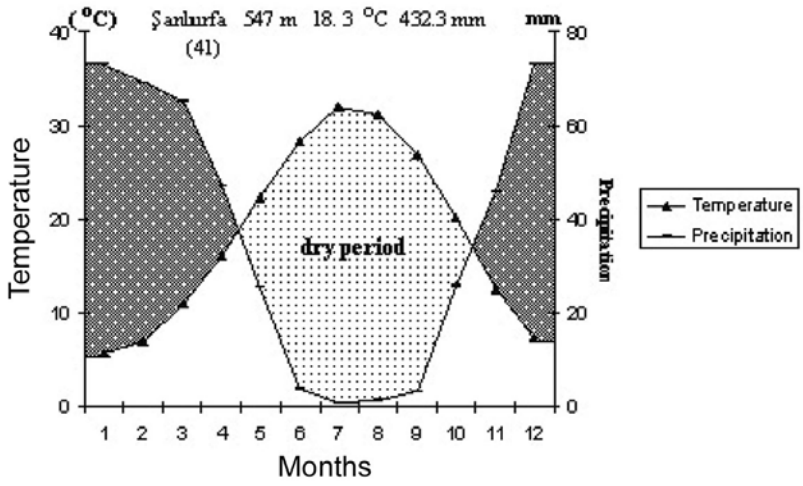

Fig. 2. Ombrothermic diagram of Şanlıurfa.

Tek Tek Mountains are generally dominated by steppe vegetation formed by regressive succession. Most of Tek Tek Mountains were covered for long years with shrub vegetation which consisted of *Pistacia terebinthus* subsp. *palaestina*. It was exposed to erosion due to excessive deforestation and overgrazing and paved the way for non-agricultural naked rocky and steppe.

According to the floristic study conducted by Kaya and Ertekin (2009) in this preserved area, 265 taxa were recorded and generally these taxa were found in other parts of Tek Tek Mountains during this study as well. Some reasons have prevented Tek Tek Mountains to have a rich floristic structure, such as small difference in altitude (550 - 800 m), rough structure of the area, lack of a microclimatic zone and anthropogenic effects. *Ceraso tortusae* - *Pistacietum palaestinae*, which covers the entire hillsides of valleys, which lie to the north of the national park represents a shrub vegetation which is destroyed from place to place. *Pistacia terebinthus* subsp. *palaestina,* which determines the physiognomy of the association, is an eastern Mediterranean element that spreads over the eastern part of Mediterranean basin and is one of the permanent elements of maquis.

Two steppe associations (*Achilleo aleppicae* - *Centaureetum virgatae* and *Eryngietum cretico* - *virentis*) described in the national park. *Achilleo aleppicae* - *Centaureetum virgatae* spreads especially over the northward and north-eastward hillside of the marble quarry. *Centaurea virgata* is dominant on the physiognomy of the association. This taxon is an Irano-Turanian element and shows wide distribution in northwest, east and especially in central areas of Anatolia in Turkey (Davis 1965-1985). The association is secondary vegetation formed as a result of the anthropogenic degeneration of *Pistacia* population. The evidence for this can be provided as follows: *Pistacia terebinthus* subsp. *palaestina*, *Cerasus microcarpa* subsp. *tortusa*, and *Ficus carica* subsp. *rupestris* are found as individuals here and there in somewhat rocky slope hillsides within the diffusion area of the association. *Eryngium campestre* subsp. *virens* determines the physiognomy of *Eryngietum cretico – virentis*. It can be generally found in all arid habitats in

Turkey. This is the most widely spread association in the national park area. It displays a rather weak diffusion outside the stony areas.

Table 2. ***Ceraso tortusae - Pistacietum palaestinae*** **ass. nova. (Holotypus: relevé 8).**

	Relevé no.	1	2	3	4	5	6	7	**8**	9	10	
	Size of plot (m²)	400	400	400	400	400	400	400	**400**	400	400	
	Parent rock	LS	LS	LS	LS	LS	LS	LS	**LS**	LS	LS	Presence
	Inclination (°)	5	5	10	5	25	40	20	**30**	30	40	
	Altitude (m)	550	570	630	590	680	680	690	**670**	650	690	
	Exposition	W	S	N	S	N	N	N	**N**	S	N	
	Coverage (%)	75	70	80	65	80	75	80	**85**	70	70	
LF												
	Differential and characteristic species of the association											
Ph	*Pistacia terebinthus* subsp. *palaestina*	4	4	5	3	5	4	5	**5**	5	4	V
Ph	*Cerasus microcarpa* subsp. *tortusa*	+	1	+		1	+		**1**	+		IV
H	*Centaurea obtusifolia*			r		+	+	1	**1**		r	III
	Characteristic species of Quercion calliprini											
H	*Eryngium falcatum*		+		+		+		**+**		+	III
	Characteristic species of Quercetalia ilicis											
G	*Anemone coronaria*	+	+				+		**+**	+		III
	Characteristic species of Quercetea ilicis											
Ph	*Ficus carica* subsp. *rupestris*		+				+	+	**+**		+	III
	Companions											
Th	*Lagoecia cuminoides*	1m	2a	1m	1	1m		1	**1m**		1	IV
Th	*Crepis sancta*	+	+	+		1			**+**	+	+	IV
Th	*Trifolium stellatum* var. *s.*	1m	1	+	+		+		**+**		+	IV
Ch	*Teucrium polium*	+	+	+	+			+	**1**	1		IV
Th	*Ziziphora capitata*	+			+	+	+	+	**+**		+	IV
Th	*Trifolium speciosum*	+	+		+		+	+	**+**	+		IV
H	*Telephium oligospermum*			+	+	+		+	**+**	+		III
H	*Delphinium kurdicum*	+		+		+	+		**+**		+	III
H	*Salvia palaestina*		+		+		+		**+**	+	+	III
Th	*Trifolium scabrum*		+	+	+	+	+	+				III
H	*Tragopogon longirostris* var. *l.*		+	1		+			**1**	+		III
H	*Onopordum bracteatum* var. *b.*	+			+		+		**+**	+		III
Th	*Legousia speculum-veneris*	1			+			+	**+**	+		III
Th	*Rhagadiolus stellatus* var. *s.*	+		1					**+**	+	+	III
H	*Salvia bracteata*			+		+	+		**+**	+		III
Th	*Clypeola johnthlaspi*	+	+			+		+	**+**			III
Th	*Biscutella didyma*	+	+	+	+							II
Th	*Cicer pinnatifidium*					+	+		**+**	+		II
H	*Scorzonera mollis* subsp. *szowitzii*				+	+	+	+				II
Th	*Linaria chalepensis* var. *c.*			+			+	+		+		II
Ph	*Crataegus aronia* var. *a.*		1		+					+		II
H	*Trigonosciadium viscidulum*								**+**	+	+	II
H	*Euphorbia oxyodonta*	+	+			+						II
H	*Hypericum retusum*		+					+	**+**			II
Th	*Onobrychis aequidentata*					+			**+**		+	II
H	*Serratula cerinthifolia*				+		+		**+**			II
H	*Verbascum kotschyi*	+	+	+								II
Th	*Trifolium leucanthum*			+					**+**			I
G	*Crocus pallasii* subsp. *turcicus*	+	+									I
H	*Haplophyllum thesioides*							+	**+**			I
H	*Leucocyclus formosus* subsp. *amanicus*	+			+							I

When the chorology of the taxa detected in the national park are examined, they are usually titled as Irano-Turanian, Mediterranean and East Mediterranean. This is an evidence that the study area is in Irano-Turanian phytogeographical region (Davis 1965-1985). The fact that

Mediterranean and East Mediterranean elements occupy second and third ranks and that two of the three detected associations are dominated by taxa with Mediterranean and East Mediterranean elements verifies the view that Mediterranean vegetation in the past extended until southeast Anatolia.

Table 3. ***Achilleo aleppicae - Centaureetum virgatae*** **ass. nova (Holotypus: relevé 14).**

	Relevé no.	11	12	13	**14**	15	16	17	18	19	20	
	Size of plot (m²)	50	50	50	**50**	50	50	50	50	50	50	
	Parent rock	LS	LS	LS	**LS**	LS	LS	LS	LS	LS	LS	
	Inclination (°)	5	5	10	**15**	10	30	15	15	20	15	
	Altitude (m)	512	543	610	**620**	628	640	639	680	660	652	Presence
	Exposition	S	S	S	**N**	NE	NE	N	N	N	W	
	Coverage (%)	40	60	60	**70**	60	65	65	70	60	40	
LF												
	Differential and characteristic species of the association											
H	*Centaurea virgata*	3	3	4	**5**	5	4	4	4	5	3	V
H	*Achillea aleppica* subsp. *a.*			1	**1**	+			1		+	III
	Characteristic species of Astragalo erythrotaeni-Gundelion armatae											
H	*Torilis leptocarpa*		+		+			+	+	+		III
H	*Gundelia tournefortii* var. *armata*	+		+	+		+				+	III
	Characteristic species of Onobrychido armenae-Thymetalia lecostomi											
H	*Paronychia kurdica* subsp. *k.* var. *k.*		+	+	+							II
	Characteristic species of Astragalo-Brometea											
Th	*Xeranthemum annuum*	+		+	**1**	1	+		+	+		IV
Ch	*Teucrium polium*	+		1	+	+		+	+		+	IV
H	*Ajuga chamaepitys* subsp. *c.* var. *c.*		+		+			+	+			II
H	*Poa bulbosa*		+				+		+		+	II
Th	*Ziziphora tenuior*		+		+						+	II
Th	*Bromus japonicus* subsp. *j.*				+	+			+			II
	Companions											
Th	*Aegilops triuncialis* subsp. *t.*		+	1	**1**	+		+	1	1	+	IV
Th	*Ziziphora capitata*	1		+	+		+		+	+	+	IV
Th	*Tordylium hasselquistiae*		+	+		+		+		+		III
H	*Pimpinella corymbosa*	+			+			+		+		II
H	*Achillea membranacea*			+	+		+		+			II
H	*Ballota saxatilis* subsp. *s.*		+	+			+		+			II
H	*Astragalus aleppicus*		+		+		+			+		II
Ch	*Thymbra spicata* var. *s.*		+		+			+			+	II
H	*Fibigia eriocarpa*				+	+	+					II
Th	*Onobrychis crista-galli*			+		+			+			II
H	*Centaurea stapfiana*			+			+				+	II
H	*Phlomis bruguieri*			+			+				+	II
H	*Phlomis kurdica*		+						+		+	II
Th	*Xeranthemum longipapposum*	+		+		+			+			II
H	*Scutelleria orientalis* subsp. *haussknechtii*		+		+				+			II
Th	*Ononis viscosa* subsp. *breviflora*				+		+				+	II
Th	*Euphorbia chamaesyce*			+					+			I
Th	*Picris kotschyi*				+			+				I
H	*Sideritis libanotica* subsp. *kurdica*				+			+				I
Th	*Anacyclus nigellifolius* subsp. *orientalis*			+				+				I
H	*Achillea wilhelmsii*		+				+					I
H	*Anarrhinum orientale*				+			+				I
G	*Asphodeline damascena* subsp. *gigantea*			+				+				I
G	*Hyacinthella nervosa*				+						+	I
Th	*Hedypnois cretica*				+							I
H	*Johrenia dichotoma* subsp. *d.*			+		+						I

According to Zohary (1973), Irano-Turanian phytogeographical region is dominated by hemicryptophtyes and chamaephytes. When the life forms of the taxa detected in national park are examined according to Raunkiaer (1934), therophytes occupy the first rank in terms of ratio, but

hemicrytophytes determine the physiognomy which is actually at the second rank; this fact verifies this viewpoint.

Table 4. *Eryngietum cretico - virentis* ass. nova (Holotypus: relevé 22).

	Relevé no.	21	**22**	23	24	25	26	27	28	29	30	
	Size of plot (m²)	50	**50**	50	50	50	50	50	50	50	50	
	Parent rock	LS	**LS**	LS	LS	LS	LS	LS	LS	LS	LS	
	Inclination (°)	2	**5**	2	2	2	2	3	2	3	2	
	Altitude (m)	W	**W**	W	W	W	SE	E	W	E	E	
	Exposition	E	**E**	E	E	E	E	E	E	E	E	Presence
	Coverage (%)	60	**65**	40	55	60	50	40	50	50	40	
LF												
	Differential and characteristic species of the association											
H	*Eryngium campestre* subsp. *virens*	4	**4**	4	3	4	4	3	3	4	3	V
H	*Eryngium creticum*	1	**1m**	1	1m	+	+	+	1	+	1	V
	Characteristic species of Astragalo erythrotaeni-Gundelion armatae											
H	*Gundelia tournefortii* var. *armata*	+	**1**	+		+				1		III
	Characteristic species of Onobrychido armenae-Thymetalia lecostomi											
H	*Paronychia kurdica* subsp. *k.* var. *k.*		+			+						I
	Characteristic species of Astragalo-Brometea											
Th	*Xeranthemum annuum*		+		+	+		+		+		III
H	*Ajuga chamaepitys* subsp. *chia* var. *c.*	+	+				+		+			II
Th	*Bromus japonicus* subsp. *j.*		+		+				+			II
	Companions											
H	*Astragalus diphtherites* var. *d.*	+	**1**	+	+		1		+		+	IV
H	*Echinops orientalis*		+	+	+		+	+		+	+	IV
Th	*Aegilops triuncialis* subsp. *t.*	+	**1**				+	1m	+		+	III
Th	*Echinaria capitata*		+	1	1	+	+			+		III
Th	*Ziziphora capitata*		**1**	+	+		1	+			+	III
Th	*Trifolium pauciflorum*	+	+				+		+	+		III
Th	*Trigonella spruneriana* var. *s.*	+	+			+	+				+	III
Th	*Avena sterilis* subsp. *s.*				+	+	+	+			+	III
Th	*Erodium cicutarium* subsp. *c.*		+		+			+	+		+	III
Th	*Trifolium scabrum*		**1**		+	+				+		II
Th	*Medicago coronata*			+		1		+	+			II
Th	*Scandix stellata*		+		+			+			+	II
Th	*Trigonella filipes*	+					+	+			+	II
H	*Dianthus zonatus* var. *hypochlorus*		+			+			+	+		II
Th	*Xeranthemum longipapposum*			+	+	+			+			II
H	*Hordeum bulbosum*		+			+		+			+	II
Ch	*Thymbra spicata* var. *s.*	+				+			+		+	II
Th	*Cephalaria setosa*		+		+	+				+		II
G	*Gagea reticulata*	+	+							+	+	II
Th	*Trigonella mesopotamica*		+			+	+			+		II
Th	*Alyssum szowitsianum*	+				+		+				II
Th	*Trifolium cherleri*				+	+	+					II
G	*Gladiolus atroviolaceus*	+						+			+	II
Th	*Cerastium dichotomum* subsp. *d.*	+				+			+			II
Th	*Erodium ciconium*	+			+	+						II
H	*Sanguisorba minor* subsp. *magnolii*		+			+						I
Th	*Crepis foetida* subsp. *commutata*	+					+					I
H	*Eryngium glomeratum*	+					+					I
Th	*Veronica hederifolia*			+						+		I
H	*Aristolochia bottae*					+						I

Natural vegetation of the national park area, which was surrounded by villages and cultivated areas in the past, has been rapidly destroyed due to overgrazing and anthropogenic factors, and in these areas naked lands occurred with the contributing effect of wind erosion. Tek Tek Mountains

consist of secondary steppe vegetation in general except for the shrub vegetation in an area with storable vegetation as it was under the impact of such biotic and abiotic factors.

As a result, in the national park, one association belonging to shrub vegetation and two associations belonging to steppe vegetation have been defined. All of these syntaxa are new to science because no similarity of these syntaxa with any others introduced before has ever been found. These syntaxa and their upper syntaxonomic units are shown below.

Shrub vegetation

Class: *Quercetea ilicis* Br.-Bl. ex A. Bolòs y Vayreda 1950

Order: *Quercetalia ilicis* Br.-Bl. ex Molin. 1934

Alliance: *Quercion calliprini* (Zohary 1962) Quézel, Barbéro & Akman 1978

Association: *Ceraso tortusae – Pistacietum palaestinae* ass. nova

Steppe vegetation

Class: *Astragalo microcephali - Brometea tomentelli* Quézel 1973

Order: *Onobrychido armenae - Thymetalia leucostomi* Akman, Ketenoğlu & Quézel 1985

Alliance: *Astragalo erythrotaeni - Gundelion armatae* Kaya & Ketenoğlu 2010

Association: *Achilleo aleppicae - Centaureetum virgatae* ass. nova

Association: *Eryngietum cretico - virentis* ass. nova

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