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Studies on the chorology, ecology, morphology and conservation strategies of *Orchis anatolica* Boiss (Orchidaceae)

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Abstract

Orchis anatolica Boiss. is one of the Mediterranean species, which has wide distribution in Turkey. In this study, plant and soil samples of *O. anatolica* were taken from 26 natural populations in Turkey. There were one hundred ninety locality records in the Mediterranean region of Turkey, but we recorded two hundred sixteen localities thus adding twenty six new localities to the list. Twenty morphological parameters of *O. anatolica* were evaluated. The correlation coefficients between generative characters and vegetative characters were lower than the character groups of correlation coefficients between themselves. It is found from sea level upto 1700 m. Most common habitats of *O. anatolica* are macchie, forest lands and stony soils. The soils are loamy, clayey- loam and sandy-clayey- loam and rich in organic matter. The pH of the soils varies from 5.87 to 7.92. Although *O. anatolica* has wide distribution in Turkey, different types of land uses are posing a threat for it and restricting its distributional area. Lacking the legal regulations about conservation of the *O. anatolica* populations is one of the most striking requirement.

Key words

Orchis anatolica, Orchidaceae, Chorology, Ecology habitat, Morphology, Conservation

Introduction

There are approximately 19,500 species of Orchidaceae all around the world. (Dreesler, 1993). Orchidaceae is one of the noticeable families, it has great economic value. In addition to having attractive flowers, it is used as food and for medicinal purposes (Pfeifer *et. al*., 2006, Gorchakovskii and Igosheva, 2003; Waite and Hutchings, 1991; Waite, 1989; Coates *et. al.*, 2002).

The classification of Orchidaceae although presented in 1825, final classification was prepared by Robert Dressler (Sheehan and Sheehan, 1994). In Turkey, Renz and Taubenheim published the classification of Orchidaceae in 1984. Out of these species *O. anatolica* Boiss. has been first described in 1844 by Edmond Boissier. The first record in the Flora of Turkey is from A2 (A) Bursa: near Bursa, Thirke (type of *O. rariflora*) and Uludag, Sintenis 1883:339 (Renz and Taubenheim, 1984).

The distribution of *O. anatolica* around the world has been recorded in Greece, Cyprus, Lebanon, North Iraq, Northwest Iran, Turkey and East Aegean islands (Renz and Taubenheim, 1984). The Kew Gardens has listed its distribution from Aegean Islands to Israel and West Iran, Southeastern Europe, Greece, Kriti, Western Asia, Cyprus, East Aegean Islands, Iran, Iraq, Lebanon-Syria, Palestine and Turkey (Kew Gardens, 2010).

Phytogeographically, *O. anatolica* lies in the East Meditteranean region. It is distributed in West and Southern Anatolia, Aegean, Mediterranean and East Anatolian regions in Turkey (Renz and Taubenheim, 1984; Donner, 2007; Kreutz, 2009)

Systematic Position:

Kingdom : Plantae
Division : Magnoliophyta
Class : Liliopsid
Order : Asparagales
Family : Orchidaceae
Subfamily : Orchidiodeae
Tribe : Orchideae
Subtribe : Orchidinae
Genus : Orchis
Species : *O. anatolica*

O. anatolica is locally known as "Dilicikik or Dilicikirik, Gelincik, Dildamak, Damartartik or Damataatik, Katirtimagi, Anadolu salep otu, Tespih salebi, Yayla salebi" in Turkey (Sezik, 1969; Baytop, 1997; Tuzlaci, 2006).

Description: It is similar to *O. quadripunctata*, but spike lax, 5-10 flowered; bracts nearly equalling ovary; flowers large, rose-purple, seldom white, with purple dots and lines in the centre of labellum; sepals (5-)7-11 × 3.5-4 mm, spreading or ± reflexed, ovate-obtuse; labellum ovate, nearly 10-15 mm, 3-lobed, cuneate at base; lateral lobes obliquely rhombic, truncate, middle lobe ± rectangular to cuneate-oblong, truncate or slightly emarginate. Spur with distinctly dilated orifice, slender, longer than ovary, to 3 cm, ± directed upwards with up-curved tip. Flowering time is March-May. It prefers macchia, scrub areas, and *Pinus* forest and grows between 0-1650 m asl (Renz and Taubenheim, 1984).

The spur positions are diagnostic feature for key, it was described as curving upwards or straight and directed upwards, sometimes ± horizontal or clearly directed downwards. Spur is elongated or cylindrical, dilated at base or not dilated. Sepal's spreading, labellum and bract: ovary ratios are utilized as remarkable reference points in terms of diagnostic characters (Renz and Taubenheim, 1984). *O. quadripunctata* which has a high rate of similarity with *O. anatolica*, is different from *O. anatolica* with its cylindrical spike, bracts being about half of length of ovary, spur, clearly directed downwards and exceeding ovary (Renz and Taubenheim, 1984). *O. anatolica* differs from *O. mascula, O. laxiflora* and *O. palustris* by its spur properties such as elongated/cylindrical linear-conical, acuminate, clearly dilated at base, additionally its spur is longer than ovary compared to these species (Renz and Taubenheim, 1984).

Flowering period continues from the end of March to the end of May depending on the altitude. Its distribution begins from low planes and continues up to sub-montane belt (1600 m). The habitats of *O. anatolica* vary among thin pine forests, shrublands and shady parts of macchia lands. The soils of these sites are dry, alkaline or light acidic (Kreutz, 2009).

O. anatolica shows psilate-scabrate exine characteristic in the pollen micromorphology. However, *O. quadripunctata* and *O. anatolica* with presumably identical pollination biology, have different exine morphology (Lumaga *et al*., 2006).

Orchidaceae has numerous and very small seeds. Soil microfungi have great effect on the seed germination of the species of this family (Arditti ,1967; Arditti 1992; Arditti and Ghani, 2000). The seeds of some species show a long dormancy lasting for 7 to 8 years. The initial leaves of the plant appear 4 years after the germination of the seeds (Sezik, 1984).

Very different results have been reported on the cell reproduction of Orchidaceae species (Gonulsen, 1983; Caglayan *et al*., 1997; 1998). The cell reproduction has been achieved only in *O. anatolica* (Caglayan *et al*., 1997; 1998). Reproduction of *Orchis* species under artificial conditions in the nutrient selective media varies from species to species as well as hormone concentration and some environmental factors. The determination of media requires species specific studies (Onal, 1999; Caglayan *et. al.*, 1998).

Morphological, chrological and ecological characteristics were investigated here to provide suggestions for nature conservation program of this species, because the tubers of *O. anatolica* are collected for salep (winter beverage), ice cream and drug production.

Materials and Methods

O. anatolica samples were collected from 26 natural populations in Turkey during the years 2007-2009. The morphological features were recorded on randomly selected 118 individuals from 17 field plots (Table 1). 20 morphological parameters were measured on mature tubers, leaf and flower from each sample collected from the field.

The morphological characteristics of *O. anatolica* investigated here included plant length, below ground part of the plant, tuber length and width, longest leaf length and width, leaf number and bract length, flower number. Besides, in the flower parts dorsal and lateral sepal length, labellum length and width, petal length, spur length, ovary length, bract/ovary, spur/ovary, pollen and caudiculum lengths were measured as generative morphological features.

Soil samples were taken from 0-5 and 5-15 cm depths and volume weight (g l^{-1}), fine soil weight (g l^{-1}), skeleton weight (g l^{-1}), sand (%), silt (%), clay (%) (Gulcur, 1974), pH (Mc Lean, 1982)., organic carbon (%) (Nelson and Sommers, 1982), total nitrogen (N %) (Jackson, 1962; Bremner and Mulvaney, 1982) and C:N ratio were determined.

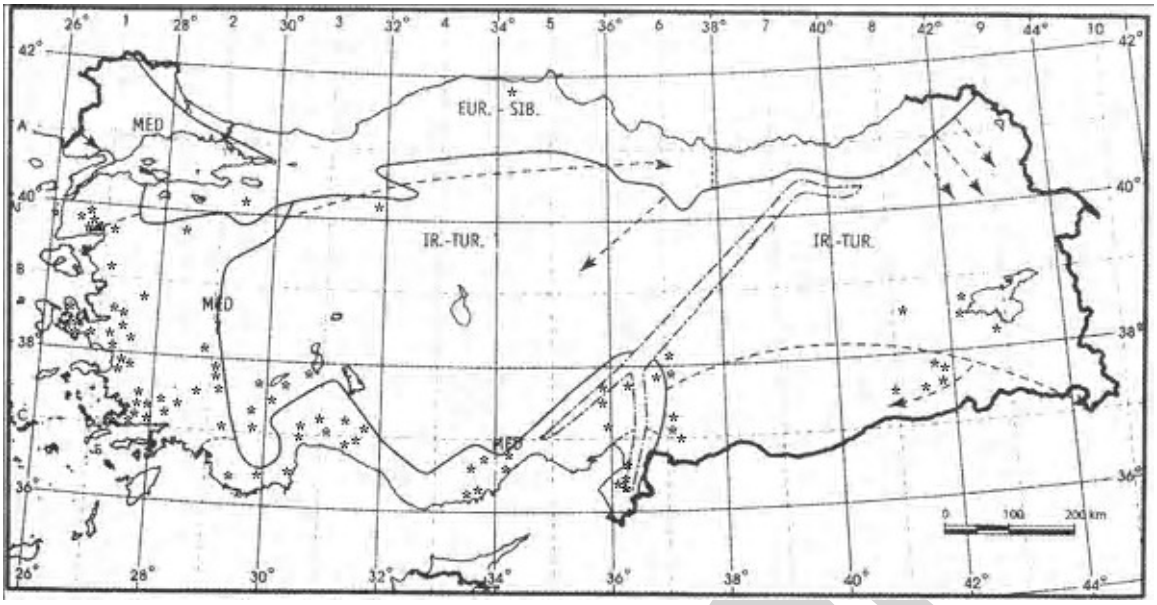

Fig. 1: Map of distribution of *O. anatolica* in Turkey. **O. anatolica*. EUR.-SIB.: Euro-Siberian phytogeographical region, IR.-TUR.: Irano-Turanian phytogeographical region, MED: Mediterranean phytogeographical region, X: Middle European part of Euro-Siberian phytogeographical region → Mediterranean elements

Morphological characteristics and soil properties were analysed by descriptive statistics. Person correlation coefficients were calculated in SPSS 13 (Kalipsiz, 1981; Ozdamar, 2002).

Results and Discussion

Chorology: One of the initial records has been by O. Schwarz (1933) (EGE herbarium, code 23127). 190 records were noted from various studies; and EGE (Faculty of Science Herbarium of Ege University), ISTE (Faculty of Pharmacy Herbarium of Istanbul University) and ISTF (Faculty of Science Herbarium of Istanbul University) Herbarium records, publications (Dusen, 2001; Duran, 2002; Tufekci *et. al*., 2002; Deniz and Sumbul 2004; Varol *et al*., 2004; Altiok and Behcet, 2005; Aytepe, 2007; Varol, 2006; Kreutz, 2009) were evaluated during this study. A total of 26 additional records reported here for the first time bringing the number of records to 216. The noteworthy portions of the records exist between 36°00' – 40°00' latitudes and 26°00' – 36°50' parallels (Fig. 1). *O. anatolica* is mostly distributed in the Mediterranean phytogeographical region of Turkey (Fig. 1).

Mophological features: 20 morphological characters of *O. anatolica* species are presented in Table 2 with their range, minimum, maximum, mean and standard deviation. Description of *O. anatolica* with numerical data has not been used too much in the Flora of Turkey and also Flora Europea (Tutin *et al*., 1980; Renz and Taubenheim, 1984). In this study, morphological features of *O. anatolica* have been evaluated with numeric data.

Some of the measurements were generally consistent with the description given in the Flora of Turkey. According to Flora of Turkey, the flower number is given as 5-10, and labellum lenght 10-15 mm (Renz and Taubenheim, 1984). In this study, flower numbers were recorded as 2 to 13 and labellum length was 7 to 16 mm. Gonuz and Ozorgucu (1995) have examined some morphological features such as stem length, number of basal leaves, basal leaf length- width, tuber length- width, flower numbers, bract length- width, sepal length- width, labellum length- width of *O. anatolica* from six different localities. Although Gonuz and Ozorgucu (1995) have reported plant length as 20.65 cm (maximum), leaf numbers as 5.1 (minimum) and bract length as 1.16 cm, in our results these measurements were 28.01 cm, 4.5 and 0.95 cm respectively. The reason for this could be habitat differences and the number of localities.

118 *O. anatolica* plant samples investigated by us were evaluated within 20 morphological characters. All results were discussed with the help of correlation analysis. According to correlation analysis it was observed that both generative characters (1-7) and vegetative characters (8-20) had higher Pearson correlation coefficient among themselves (Table 3). Besides, some morphological properties of bract, spur, ovary, bract/ovary and spur/ovary had lower correlation coefficient with others characters. All these findings reveal that these features are of diagnostic nature for introducing the species numerically.

Ecological features: Altitudinal distribution was recorded at length. Some of the records are less than 1000 m, but there are also records from higher than 1500 m altitude. The altitudinal belt of the principal populations lies between 600-800 m, 26 localities were recorded from these levels (Fig. 2a). The lowest record in Turkish flora shows 200m: B2 from Balikesir, and the highest record 1260m: A5 from Kastamonu. Recently, there have been records from sea level in Izmir (EGE Herbarium) and at 1700 m height from Siirt (Isler, 2005).

Table - 1: Site properties and locations of sampling points

Sample			Altitude (m)	Slope (%)	Aspect	Adres
Sampling points	Plant	Soil				
1	1	+	188	95	North	Mugla Milas - Alaçam - Mortas district Kapiz river
2	3	+	98	74	West	Mugla Kafaca - Yesilyurt cross road
3		+	98	74	West	Mugla Kafaca - Yesilyurt cross road
4	2	+	312	20	North-Northeast	Mugla Marmaris - Datça yolu Datça Forest Enterprise Chief Kovalica
5	6	+	166	120	East	Balikesir Edremit - Güre way Before arrival to Pinarbasi
6		+	158	10	Southeast	Mugla Datça – Hizirsah village pastureland
7	5	+	1133	15	West	Kumluca - Gödene Way Altinyaka village outgoing
8	6	+	369	45	Northeast	Isparta - Sütçüler - Çandir way
9	5	+	1061	30	South	Isparta - Sütçüler entrances Ince Meryem hill
10		+	713	10	West	Balikesir - Dursunbey – on the way to Kavacik - Suçikti district
11	10	+	149	14	Northeast	Çanakkale Bayramiç Central Forest Enterprise Chief Pinarbasi village
12	10	+	709	18	South	Balikesir Edremit Kazdagi 10 km further from entrance
13	10	+	693	25	North-Northeast	Slopes on the left side on the way outgoing from Mugla
14	10	+	595	65	North	Mugla-Yerkesik - Ören way
15	3	+	887	2	West	Mugla Yerkesik - Ören way 2.8 km to Kiran village
16		+	915	25	West	Mugla Yerkesik - Ören way 1.8 km to Kiran village
17	9	+	927	—-	—-	Isparta - Kovada lake view terrace surrounding
18		+	1540	10	Northwest	Eskisehir - Catacik – west of Savasalani
19	12	+	658	10	West	Mugla - köycegiz way 4-5 km far from Ula
20		-	40	5	West	Antalya – Outgoing way of Kumluca towards Tekirova
21	10	-	516	—-	—-	Antalya – Kumluca
22		-	155	—-	—-	Antalya Serik - Zeytintasi cave
23	6	-	161	—-	—-	Antalya 1 to 5 km to Tepeköy sign
24		-	145	—-	—-	Kastamonu – On the way from Abana to Çatalzeytin
25	10	-	518	—-	—-	Kastamonu - On the way from Çatalzeytin to Bozkurt
26		+	87	30	East	Izmir Menderes - Selçuk way

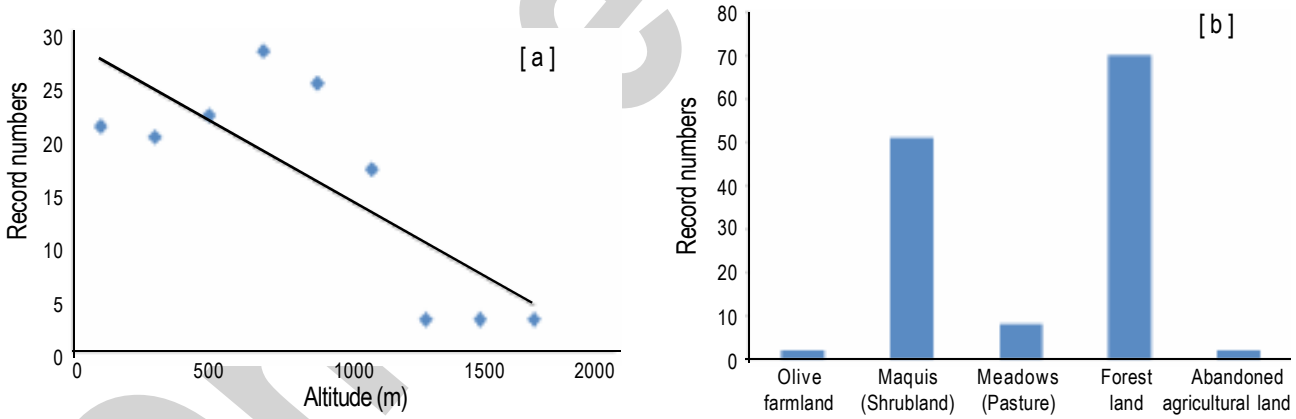

Fig. 2 : Record numbers of *Orchis anatolica* according to (a) altitude and (b) habitat selections

In the habitat selection 133 of the whole records have habitat descriptions. The main habitats selected by *O. anatolica* are forest and macchia lands (shrub lands), which contribute up to 52 and 38 % respectively. *O. anatolica* shares the macchia lands and in the forest, it generally survives in more open light receiving spaces formed in the opened patches. The parent rock is generally lime stone , but it is also found on serisite schist and conglomerate. The rock depth is generally surface or shallow (<25 cm), in some plots at mid-depth deep soils were detected. This depicts that the species doesn't make any specific exposure selection.

Table 4 shows that the tuber lies in the soil between 30 and 100 mm, as such 0-5 cm soil depth provides sufficient media for seed germination. However, 5-15 cm soil depth has more intensive effect on growth of tuber. Soil volume weight at 0-5 cm depth (seed germination depth) is 1017.59 g l^{-1}. Soil texture shows clay content as 22.2 % and can be ranked as mid-textured soil (Cepel, 1988).

Table - 2: Morphological characters of *Orchis anatolica*

	Sign	N	Range	Min	Max	Mean	SD
Length (mm)	01	118	360	130	490	280.1 ± 6.5	70.9
Underground part (mm)	02	115	70	30	100	52.0 ± 1.2	13.2
Tuber width (mm)	03	112	18	4	22	11.2 ± 0.4	3.8
Tuber length (mm)	04	112	19	9	28	16.7 ± 0.4	4.5
Leaf number	05	118	5	3	8	4.5 ± 0.1	1.1
Width of longest leaf (mm)	06	116	18	8	26	14.6 ± 0.3	2.9
Length of longest leaf (mm)	07	116	103	45	148	87.3 ± 2.2	23.8
Flower number	08	118	11	2	13	6.8 ± 0.3	3.0
Bract length (mm)	09	118	13	4	17	9.5 ± 0.2	2.6
Ovary (mm)	010	118	15	8	23	16.2 ± 0.3	3.0
Labellum width (mm)	011	118	11	7	18	12.6 ± 0.2	2.1
Labellum length (mm)	012	118	9	7	16	10.2 ± 0.2	2.0
Spur length (mm)	013	118	20	10	30	19.4 ± 0.3	3.4
Dorsal sepal length (mm)	014	118	6	5	11	7.7 ± 0.1	1.2
Lateral sepal length (mm)	015	118	7	5	12	8.3 ± 0.1	1.4
Petal length (mm)	016	118	5	4	9	6.0 ± 0.1	0.9
Pollinium	017	118	1	1	2	1.1 ± 0.0	0.2
Caudiculum	018	113	1	1	2	1.7 ± 0.0	0.4
(Bract/Ovary)*100	019	117	68	32	100	58.8 ± 1.3	14.0
(Spur/Ovary)*100	020	118	170	80	250	122.2 ± 2.2	24.4

N = Number of plant individuals; Sign= 01 to 20 refer to morphological characters on the left column.

Soils have 38.8 % stoniness in terms of weight and rank as mid-stony soils (Cepel, 1988) (Table 4). pH of the soils on average basis is 6.98 i.e. they are neutral, soils have 4.67 % organic carbon revealing richness of humus, the total nitrogen content of the soils is 0.320 % and C:N ratio is 23.41.

At 5-15 cm soil depth stoniness slightly increases and reaches 43.2 %, revealing very stony soils, in the soil texture clay content is 29.7 % and ranks as mid-textured soil (Cepel, 1988). Soil texture at 0-5 cm depth is clayey - loam, sandy - loam, sandy - clayey - loam, clay, and at 5-15 cm depth clayey - loam, loam, clay, sandy - clay - loam, sandy-clay. Soil texture of the soils has been reported as silty - sand, sandy - silt, silt at 6 distribution site of *O. anatolica* (Gonuz and Ozorgucu, 1995). pH of the soils has average value of 7.15 which means they are neutral, soils have 2.75 % organic matter revealing average richness of humus, the total nitrogen content of the soils is 0.170 % and C:N ratio is 34.59 (Table 4).

Soil characterictics of the area on which *O. anatolica* is distributed present a wide variation. The most striking feature of the soils is high skeleton content. At the sites where main rock rises to the soil surface, fine soil amount is generally too low. High rate of skeleton : fine soil leads to insufficient water economy of the soils (Cepel, 1993; Kantarci, 1980). Although sand ratio produces positive effect on the soil water budget, higher amounts of organic matter support in the balancing of water budget. *O. anatolica* can thus survive under water deficit conditions of Mediterranean climate during early spring.

Organic matter is the uppermost nutrient source of a given site (Cepel, 1995). The organic carbon amount decreases below 1 % at only one sampling plot among the all sampled points. Based on the findings of this research, it is predicted that *O. anatolica* shows its distribution on the soils rich in organic matter. In addition, pH ranges between 5.87 – 7.75 at 0-5 cm depth while it increases to 6.11-7.79 at 5-15 cm soil depth. pH values of the soils has been reported to lie between 7.46-7.92 at 5 distribution site of *O. anatolica* in west Anatolia (Gonuz and Ozorgucu, 1995). Nutrient uptake is smoothly accessible between the pH ranges mentioned above (Aydemir and Ince, 1988; Kacar, 1989; Ozturk and Secmen, 2004).

Conservation of the *Orchis anatolica:* Orchidaceae family is threatened globally due to 1) degradation of habitats, 2) collection. First group is divided to sub-groups such as: a) log production and transport, b) agriculture and plantation, c) dispatch of habitat, d) development of urban places, e) mining. Second group has sub-divisions like a) trade of the plant as an ornamental plant, b) unconscious collectors, c) utilization of some species for medicine or drug production (Batty *et al*., 2002).

The species of Orchidaceae family were collected in Turkey in large amounts (Sezik, 1967), but the export of tuber was forbidden by Ministry of Agriculture in 1974 (Sezik, 1984). "Convention on international trade in endangered species of wild fauna and flora" had been approved with the law number 4041 on 27th September, 1994 and published in Official Gazette numbered 22672 on 20th June, 1996 (Anon., 1999). Besides as documented in the "Red Data Book of Turkish Plants" 25 species of the family are facing various degrees of threat of extinction (Ekim *et al*., 2000).

Table - 3: Numbers of plant sample and Pearson correlation coefficent ($p<0.05$)

	o1	o2	o3	o4	o5	o6	o7	o8	o9	o10	o11	o12	o13	o14	o15	o16	o17	o18	o19	o20
o1	**1**	**0.561**	**0.581**	**0.532**	**0.520**	**0.524**	**0.749**	0.653	0.195	0.452	0.135	0.235	0.373	0.224	0.380	0.263	0.233	0.073	-0.131	-0.115
o2	**118**	**1**	**0.192**	**0.396**	**0.326**	**0.456**	**0.446**	0.493	0.317	0.309	0.004	0.216	0.192	0.154	0.357	0.319	-0.064	0.225	0.103	-0.137
o3	**115**	**115**	**1**	**0,715**	**0.531**	**0.475**	**0.623**	0.461	0.301	0.355	0.345	0.323	0.416	0.291	0.338	0.237	0.331	-0.069	0.084	0.028
o4	**112**	**112**	**112**	**1**	**0.588**	**0.530**	**0.552**	0.549	0.468	0.469	0.337	0.379	0.311	0.423	0.413	0.422	0.210	0.088	0.188	-0.169
o5	**112**	**112**	**112**	**112**	**1**	**0.353**	**0.448**	0.482	0.298	0.335	0.161	0.345	0.244	0.215	0.238	0.244	0.119	0.041	0.089	-0.096
o6	**118**	**115**	**112**	**112**	**118**	**1**	**0.453**	0.643	0.461	0.354	0.217	0.133	0.250	0.199	0.337	0.213	0.079	0.251	0.273	-0.127
o7	**116**	**114**	**112**	**112**	**116**	**116**	**1**	0.512	0.189	0.426	0.083	0.291	0.343	0.274	0.381	0.281	0.277	-0.008	-0.096	-0.116
o8	116	114	112	112	116	116	116	**1**	**0.289**	**0.228**	**0.057**	**0.065**	**0.065**	**0.070**	**0.161**	**0.089**	**0.098**	**0.042**	**0.151**	**-0.159**
o9	118	115	112	112	118	116	116	**118**	**1**	**0.521**	**0.338**	**0.453**	**0.403**	**0.487**	**0.542**	**0.548**	**0.008**	**0.283**	**0.724**	**-0.085**
o10	118	115	112	112	118	116	116	**118**	**118**	**1**	**0.260**	**0.508**	**0.531**	**0.440**	**0.492**	**0.434**	**0.222**	**0.089**	**-0.137**	**-0.527**
o11	118	115	112	112	118	116	116	**118**	**118**	**118**	**1**	**0.421**	**0.422**	**0.394**	**0.422**	**0.342**	**-0.058**	**0.300**	**0.221**	**0.185**
o12	118	115	112	112	118	116	116	**118**	**118**	**118**	**118**	**1**	**0.497**	**0.625**	**0.535**	**0.587**	**0.113**	**0.223**	**0.096**	**0.007**
o13	118	115	112	112	118	116	116	**118**	**118**	**118**	**118**	**118**	**1**	**0.399**	**0.529**	**0.421**	**0.201**	**0.205**	**0.058**	**0.402**
o14	118	115	112	112	118	116	116	**118**	**118**	**118**	**118**	**118**	**118**	**1**	**0.738**	**0.750**	**0.051**	**0.241**	**0.180**	**0.011**
o15	118	115	112	112	118	116	116	**118**	**118**	**118**	**118**	**118**	**118**	**118**	**1**	**0.821**	**0.119**	**0.278**	**0.189**	**0.066**
o16	118	115	112	112	118	116	116	**118**	**118**	**118**	**118**	**118**	**118**	**118**	**118**	**1**	**0.108**	**0.236**	**0.280**	**0.01**
o17	118	115	112	112	118	116	116	**118**	**118**	**118**	**118**	**118**	**118**	**118**	**118**	**118**	**1**	**-0.392**	**-0.137**	**0.042**
o18	118	115	112	112	118	116	116	**118**	**118**	**118**	**118**	**118**	**118**	**118**	**118**	**118**	**118**	**1**	**0.235**	**0.133**
o19	113	110	107	107	113	111	111	**113**	**113**	**113**	**113**	**113**	**113**	**113**	**113**	**113**	**113**	**113**	**1**	**-0.248**
o20	117	114	111	111	117	115	115	**117**	**117**	**117**	**117**	**117**	**117**	**117**	**117**	**117**	**117**	**112**	**117**	**1**

Table - 4: General characteristics of the soils and sampling sites

Variable	N	Range	Min	Max	Mean	SD
0 - 5 cm						
Volume weight (g l^{-1})	19	880.60	634.40	1515.00	1017.59 ± 48.35	210.76
Fine soil weight (g l^{-1})	19	694.90	394.10	1089.00	622.74 ± 39.53	172.30
Skeleton weight(g l^{-1})	19	829.20	9.70	838.90	395.08 ± 50.28	219.18
Sand (%)	20	38.81	38.94	77.75	57.26 ± 2.37	10.62
Silt (%)	20	26.93	11.67	38.60	20.51 ± 1.27	5.70
Clay (%)	20	26.40	10.50	36.90	22.20 ± 1.65	7.38
pH	20	1.88	5.87	7.75	6.98 ± 0.10	0.44
Organic Carbon (%)	19	12.82	0.94	13.76	4.67 ± 0.81	3.52
Total Nitrogen	19	0.74	0.04	0.78	0.32 ± 0.06	0.26
C:N (Carbon:Nitrogen)	18	103.63	5.73	109.36	23.41 ± 5.59	23.71
5 - 15 cm						
Volume weight (g l^{-1})	19	1001.60	744.40	1746.00	1158.83 ± 52.62	229.37
Fine soil weight (g l^{-1})	19	584.10	401.30	985.40	658.36 ± 37.33	162.71
Skeleton weight(g l^{-1})	19	689.40	92.90	782.30	500.82 ± 47.18	205.67
Sand (%)	20	38.36	23.52	61.88	46.65 ± 2.89	12.93
Silt (%)	20	37.56	8.94	46.50	23.70 ± 1.70	7.60
Clay (%)	20	36.98	14.64	51.62	29.65 ± 1.93	8.61
pH	20	1.69	6.11	7.79	7.15 ± 0.10	0.44
Organic Carbon (%)	19	5.26	0.68	5.94	2.75 ± 0.35	1.51
Total Nitrogen	19	0.53	0.02	0.55	0.17 ± 0.04	0.16
C:N (Carbon:Nitrogen)	18	183.43	4.64	188.07	34.59 ± 10.09	42.81
Altitude	19	1453.00	87.00	1540.00	597.79 ± 95.42	415.91
Slope	19	120.00	0.00	120.00	32.53 ± 7.58	33.04
Surface stoniness	19	80.00	5.00	85.00	43.42 ± 6.20	27.03

N = Number of sample

Major legal sources of constitution for Orchidaceae are: 1) International agreements (CITES, Biodiversity Agreement etc.), 2) the regulations of national law: a) fundamental law, b) forest law numbered 6831, c) olive farmland law, d) pasture law. While forest and macchia (shrub lands) are conserved by forest law, any law providing restriction to collection of the species from private macchia lands, olive farm lands and agricultural lands is not valid (Tecimen *et al*., 2010).

The alteration of land use type of the habitats of *O. anatolica* is continuing, predominantly as the urban land increases, degradation of natural patches at the borders of agricultural lands and cultivation of olive farmlands are leading to the reduction of biotopes. In macchia lands, *Orchis* species select the spaces among the bushes. *Orchis* species at natural sites cannot survive in open lands. Therefore, a decrease in the spaces endangers the sustainability of *Orchis* species. *Orchis* species show distribution under olive farmlands. Soil cultivation leads towards the disappearance of the plants temporarily. No individuals exist under annually cultivated lands. The alteration of pasturelands into agricultural lands or plantations in forest gaps are also dangerous for these species. No comprehensive inventory is available, so widespread evaluation is missing.

Inevitably construction of a plan covering conservation of Orchidaceae species facing extinction and their re-introduction to nature is a neccessity (Anon, 2002; 2004; Sharp, 2004; Holland, *et. al.*, 1996; Bowles, 1999). A valid legislation regulating collection of species from private land should be put in practice. Cultivation of olive farmlands at inclined topography should be forbidden by legislations. The sections of the conservation plan are given below:

a) *O. anatolica* and its relations with other species.
b) life-cycle of *O. anatolica* should be evaluated at length.
c) determination of habitats.
d) current distribution of *O. anatolica* and determination of population characteristics.
e) determination of the threatening factors.
f) determination of the preventions against threatening factors.
g) monitoring *O. anatolica* populations.
h) cost analysis of the conservation plan.

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