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Taxonomical and Ecological Investigations on Some Geophytes Growing Around Denizli Province (Turkey)

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Abstract: In this study, the taxonomical and ecological features of some geophytes which grow naturally around Denizli province have been investigated. From this research, which was performed between 1996 and 2000, 31 species belonging to 8 families have been determined. Thirteen soil parameters from 31 localities were analysed in order to establish plant and soil relations. The ecological spectra of the species are considered, comprising 16 species in macchie and phrygana (50%); 1 species in fields (1%); 7 species in high mountains (23%) and 8 species in forests (26%).

Key Words: Geophytes, taxonomy, ecology, Denizli, Turkey

Denizli (Türkiye) İli Çevresinde Yetişen Bazı Geofitler Üzerine Taksonomik ve Ekolojik Araştırmalar

Özet: Bu çalışmada, Denizli ili çevresinde doğal olarak yetişen bazı geofitlerin taksonomik ve ekolojik özellikleri araştırılmıştır. 1996-2000 yılları arasında yapılan bu çalışmaya göre 8 familyaya ait 31 tür saptanmıştır. Bitki ve toprak ilişkilerini ortaya koymak için 31 lokaliteden 13 toprak parametresi analiz edildi. Türlerin ekolojik spektrumu göz önünde bulundurulduğunda 16 tür (% 50) maki ve friganada, 1 tür (% 10) ekili alanlarda, 7 tür (% 23) yüksek dağlarda ve 8 tür (% 26) ormanlarda bulunmaktadır.

Anahtar Sözcükler: Geofit, taksonomi, ekoloji, Denizli, Türkiye

Introduction

Anatolia, which has many plant species, both widespread and endemic, is one of the richest regions for natural plants. Geophytes are an important part of this richness. "Geophyte" is the name given to herbs which stay dormant underground for the greater part of the year and have specialised food-storing underground stems such as bulbs, corms, rhizomes and tubers (Giray, 2001).

As a part of this floral richness, geophytes, with their charming flowers, comprise 15% of the Turkish flora.

Most of the geophyte species growing in Anatolia, represented by 600 species, belong to the families *Liliaceae, Amaryllidaceae, Ranunculaceae, Iridaceae, Primulaceae, Araceae, Geraniaceae* and *Orchidaceae* (Davis, 1965-1985).

While some geophytes are used as ornamental plants, others are used in medicine and as food. The economic value of these species comes from collecting and exporting their bulbs as ornamental plants. Some geophytes have been exported since the time of the Ottoman Empire. Since the species belonging to the genera *Galanthus* and *Sternbergia* are collected excessively, their populations and distributions have been damaged. In more recent times, natural bulbs have been collected from 1960 to the present (Ergun et al., 1997).

From the floristic point of view, Denizli is located in West Anatolia (Turkey) and includes Mediterranean and Irano-Turanian floristic regions. According to the Flora of Turkey grid system, Denizli belongs to grid C2 (Davis, 1965-1985). The rocks there are serpentine and limestone in general (Nebert, 1958; Taner, 1974). The climate is typically Mediterranean, but the regions around

the boundary between Denizli and Afyon show a transition between the Mediterranean and inland climates (Akman, 1993).

The aim of this study is to outline the flowering periods of geophyte taxa and to compare this data with the Flora of Turkey, to see if there are differences in the descriptions given and also to determine the ecological properties.

Materials and Methods

The underground organs (tuber, corm, bulb, rhizome) of the plants were used as the material of this study. These plants were collected from March to October, mainly in spring and autumn, during the study period 1996-2000.

The collected samples were numbered and herborised. Determinations were made according to Davis (Davis, 1965-1985).

The analysis of soil samples was performed in the soil laboratory of the Agriculture and Rural Affairs Directorate of Denizli. The analysis included: saturation pH; potassium uptake according to Kaçar (1972); soil texture; dissolving salt according to Soil Survey Staff (1951); $CaCO_3$ according to Walkley-Black (1934) and phosphorus uptake according to Bingham (1949) and Chapman (1967).

Results

As a result of our studies, 31 species belonging to 8 families have been determined. These species are as follows:

DICOTYLEDONES

GERANIACEAE

Geranium macrostylum Boiss.

Distribution: Aegean region

Altitude: 500-1900 m.

Flowering time: April-June

Habitat: In macchie, *Juniperus* and *Cedrus* forest

C2 Denizli: PAU campus area, 600 m., E. Medit.

Geranium tuberosum L.

Distribution: Widespread

Altitude: s.l.-2500 m.

Flowering time: April-June

Habitat: Rocky slopes, in macchie, fields

C2 Denizli: Çivril, Akdağ, 1750 m.

PAPAVERACEAE

Corydalis oppositifolia DC. subsp. *oppositifolia*

Distribution: Scattered

Altitude: 1300-2800 m.

Flowering time: April-July

Habitat: Stony slopes, *Juniperus* shrub

C2 Denizli: Honaz Mountain, 2000 m.

Corydalis wendelboi Lidén subsp. *wendelboi*

Distribution: Outer Anatolia

Altitude: 1000-2100 m.

Flowering time: April-June

Habitat: Shrub, screes, slopes

C2 Denizli: Çivril, Akdağ, 1900 m., Endemic

PRIMULACEAE

Cyclamen trochopteranthum O.Schwarz

Distribution: West Anatolia

Altitude: 350-1100 m.

Flowering time: February-April

Habitat: Stony ground under bushes, *Pinus brutia* forest, on limestone or serpentine

C2 Denizli: Tavas, Karataş village, 900 m., Endemic, E. Medit.

RANUNCULACEAE

Anemone coronaria L.

Distribution: North, West and South Anatolia

Altitude: s.l-900 m.

Flowering time: February-April

Habitat: *Quercus* shrub, stony slopes and meadows

C2 Denizli: Acıpayam, Bozdağ, 850 m., Medit.

Eranthis hyemalis (L.) Salisb.

Distribution: Taurus, Anti-Taurus, Upper Euphrates

Altitude: 1300-1800m.

Flowering time: April-May

Habitat: Open places

C2 Denizli: Çivril, Akdağ, 1450 m.

MONOCOTYLEDONES

ARACEAE

Arum elongatum Steven subsp. *elongatum*

Distribution: Inner Anatolia

Altitude: 400-1800 m.

Flowering time: May-July

Habitat: Limestone, serpentine rocks and *Juniperus* shrub

C2 Denizli: Pamukkale (Hierapolis), 800 m.

Dracunculus vulgaris Schott

Distribution: West Anatolia

Altitude: 200-3000 m.

Flowering time: February-June (July)

Habitat: Open rocky slopes, shrub, alpine turf and sparse coniferous woods

C2 Denizli: Pamukkale (Hierapolis), 650 m., E. Medit.

IRIDACEAE

Crocus biflorus Mill. subsp. *creweii* (Hook.f.) B.Mathew

Distribution: West Anatolia

Altitude: 200-3000 m.

Flowering time: February-June (July)

Habitat: Open rocky slopes, shrub, alpine turf and sparse coniferous woods

C2 Denizli: Honaz Mountain, 2200 m., E. Medit.

Crocus chrysanthus (Herbert) Herbert

Distribution: North, West, Central and South Anatolia

Altitude: s.l.-2200 m.

Flowering time: February-April (July)

Habitat: Open hillsides in short turf, sparse coniferous woods, shrub

C2 Denizli: Honaz Mountain, 2240 m.

Crocus baytopiorum B.Mathew

Distribution: West and South-West Anatolia

Altitude: 1300-2700 m.

Flowering time: February-April

Habitat: Limestone in sparse coniferous woods

C2 Denizli: Honaz Mountain, 2000 m. Endemic. E. Medit.

LILIACEAE

Colchicum triphyllum G.Kunze

Distribution: Mainly West, Central and South Anatolia

Altitude: 700-2100 m.

Flowering time: February-April (June)

Habitat: Stony steppe, roadside, banks, sandy open slopes near melting snow

C2 Denizli: Honaz Mountain, 2200 m., Medit.

Fritillaria carica Rix subsp. *carica*

Distribution: West Anatolia

Altitude: 200-1500 m.

Flowering time: March-May

Habitat: *Juniperus* forest, rocky places, usually on limestone

C2 Denizli: Honaz Mountain, 1800 m. Endemic. E. Medit.

Fritillaria pinardii Boiss.

Distribution: North, Inner and South Anatolia

Altitude: 1000-2500 m.

Flowering time: April-June

Habitat: Rocky hillsides and upland steppe, often by late snow patches

C2 Denizli: Honaz Mountain, 2100 m.

Gagea peduncularis (J. & C.Presl) Pascher

Distribution: West and South Anatolia

Altitude: 10-1300 m.

Flowering time: February-April

Habitat: Limestone rocks, *Pinus* forest

C2 Denizli: Honaz Mountain, 2000 m. Medit.

Hyacinthella lineata (Steudel) Chouard

Distribution: West and Inner Anatolia

Altitude: 400-1500 m.

Flowering time: March-May

Habitat: *Quercus coccifera* shrub, under *Pinus nigra*, bare overgrazed slopes with sandy loam and slopes

C2 Denizli: Honaz Mountain, 1240 m., Endemic, E. Medit.

Merendera sobolifera C.A.Mey.

Distribution: Widespread except for North Anatolia

Altitude: 1000-2400 m.

Flowering time: March-April

Habitat: Open stony areas, fields, limestone rocks by snowpatches

C2 Denizli: Çivril, Akdağ, 2000 m. Ir-Tur.

Muscari comosum (L.) Mill.

Distribution: Widespread, but rarely in North Anatolia

Altitude: s.l.-2000 m.

Flowering time: April-July

Habitat: *Pinus brutia* forest, *Quercus* woodland, near rivers, rocky slopes, common in wheat and fallow fields

C2 Denizli: PAU Campus area, 400 m., Medit.

Muscari neglectum Guss.

Distribution: Widespread

Altitude: s.l.-2300 m.

Flowering time: March-May

Habitat: *Pinus* woods, macchie, shrub, meadows, rocky limestone slopes

C2 Denizli: Aydoğdu Mountain, 900 m.

Ornithogalum nutans L.

Distribution: West, South and Central Anatolia

Altitude: s.l.-1950 m.

Flowering time: March-May

Habitat: Slopes, fields, meadows and roadsides

C2 Denizli: Honaz Mountain, 1400 m. E. Medit.

Ornithogalum umbellatum L.

Distribution: West, South and South-east Anatolia

Altitude: s.l.-1500 m.

Flowering time: March-May

Habitat: Fields, water meadows, shrub

C2 Denizli: Babadağ, 560 m.

Scilla bifolia L.

Distribution: West, South and North Anatolia

Altitude: 80-2400 m.

Flowering time: February-June

Habitat: Woods, grasslands, limestone rocks

C2 Denizli: Babadağ, 2500 m.

Tulipa armena Boiss. var. *lycica* (Baker) Marais

Distribution: Mainly South Anatolia; scattered in Inner Anatolia

Altitude: 1000-2750 m.

Flowering time: April-June

Habitat: Rocky places

C2 Denizli: Çivril, Akdağ, 1500 m. Endemic.

Tulipa sylvestris L.

Distribution: Mainly West Anatolia

Altitude: 560-3000 m.

Flowering time: March-May

Habitat: Rocky places in oak trees

C2 Denizli: Çivril, Akdağ, 1670 m.

ORCHIDACEAE

Anacamptis pyramidalis (L.) L.C.M.Rich.

Distribution: Widespread

Altitude: s.l-1750 m.

Flowering time: April-July

Habitat: Rocky slopes and in macchie and phrygana

C2 Denizli: Sarhan village, 400 m.

Comperia comperiana (Steven) Aschers. & Graebn.

Distribution: Mainly Outer and South-east Anatolia

Altitude: 500-1750 m.

Flowering time: (April) May-July

Habitat: Coniferous and deciduous forest, mainly in montane regions

C2 Denizli: Karcı village, 450 m., Ir-Tur.

Ophrys phrygia Fleischm. & Bornm.

Distribution: Inner, South and South-east Anatolia

Altitude: s.l.-1700 m.

Table 1. Plant-Soil Relations

Plants	PHYSICAL FEATURES						CHEMICAL FEATURES						
	Sand %	Clay %	Silt %	Texture	Base rock	Vegetation	$CaCO_3$ %	Salts %	Organic Matter %	N %	P (ppm)	K (ppm)	pH
Anacamptis pyramidalis	41.00	36.73	22.27	Clayey-Loam	Limestone	*Quercus coccifera*	1	0.070	1.40	0.211	0.60	35.2	7.50
Anemone coronaria	82.00	6.00	12.00	Lomy-Sand	Gneisses	*Cistus creticus*	1.0	<0.030	1.76	0.084	74.46	1730.0	5.73
Arum elongatum subsp. *elongatum*	40.57	35.70	24.30	Clayey-Loam	Limestone	*Quercus coccifera*	6.0	0.060	10.70	0.180	11.00	46.3	7.80
Colchicum triphyllum	42.88	5.20	51.92	Silty-Loam	Limestone	*Astragalus angustifolius*	7.8	<0.030	5.75	0.252	5.00	290.0	8.10
Comperia comperiana	49.56	22.80	27.64	Sandy-oam	Pebble	*Quercus coccifera*	36.0	0.067	4.40	0.187	1.70	207.5	7.86
Corydalis oppositifolia subsp. *oppositifolia*	63.89	6.46	29.64	Sandy-Loam	Limestone	*Astragalus angustifolius*	1.8	<0.030	8.74	0.314	4.73	260.0	6.21
Corydalis wendelboi subsp. *wendelboi*	70.56	17.80	11.64	Sandy-Loam	Limestone	*Astragalus angustifolius*	1.7	0.031	4.14	0.269	2.60	300.0	7.30
Crocus biflorus subsp. *creweii*	64.88	5.20	29.92	Sandy-Loam	Limestone	*Astragalus* sp-*Acantholimon* sp.	1.2	<0.030	6.14	0.308	9.90	190.0	8.10
Crocus chrysanthus	63.89	6.46	29.64	Sandy-Loam	Schist	*Astragalus* sp.	1.8	<0.030	8.74	0.314	4.73	260.0	6.21
Crocus baytopiorum	55.89	11.80	32.30	Sandy-Loam	Schist	*Astragalus* sp.-*Acantholimon* sp.	1.7	<0.030	7.00	0.250	6.73	236.6	6.02
Cyclamen trochopteranthum	51.88	11.20	36.92	Sandy-Loam	Limestone	*Quercus coccifera*	0.3	<0.030	10.04	0.186	7.30	386.0	7.60
Dracunculus vulgaris	37.10	31.20	31.70	Clayey-Loam	Neogene sediment	*Quercus ithaburensis*	-	0.050	12.04	0.250	1.80	52.4	7.03
Eranthis hyemalis	67.56	8.80	23.64	Sandy-Loam	Limestone	*Juniperus excelsa-Pinus nigra*	1.8	<0.030	5.40	0.211	3.35	172.5	6.30
Fritillaria carica subsp. *carica*	56.88	5.20	37.92	Sandy-Loam	Limestone	*Juniperus communis*	0.2	<0.030	7.04	0.196	7.30	390.0	7.50
Fritillaria pinardii	62.56	3.80	33.64	Sandy-Loam	Limestone	*Juniperus excelsa*	9.8	<0.030	9.54	0.385	2.01	430.0	7.90
Gagea peduncularis	54.56	13.80	31.64	Sandy-Loam	Limestone	*Juniperus foetidissima* forest	1.8	0.072	6.20	0.327	2.20	302.5	6.51
Geranium macrostylum	45.22	18.46	36.30	Loam	Pebble	*Quercus coccifera*	34.1	0.053	5.99	0.250	4.00	541.6	7.74
Geranium tuberosum	48.56	17.13	34.30	Loam	Schist	*Pinus brutia* forest	20.8	0.038	5.52	0.180	1.96	156.6	7.85
Hyacinthella lineata	69.56	8.80	21.64	Sandy-Loam	Limestone	*Quercus coccifera*	2.4	0.048	8.23	0.384	2.92	670.0	7.63
Merendera sobolifera	56.88	5.20	37.92	Sandy-Loam	Limestone	*Festuca varia*	0.2	<0.030	5.62	0.168	7.90	230.0	7.40
Muscari comosum	45.56	15.80	38.64	Loam	Limestone	*Juniperus excelsa* forest	2.2	0.038	6.92	0.232	2.10	257.5	7.76
Muscari neglectum	38.56	19.80	41.64	Loam	Limestone	*Quercus coccifera*	2.0	0.060	7.62	0.310	1.70	830.0	7.71
Ophrys phrygia	64.51	13.82	21.66	Sandy-Loam	Limestone	*Quercus coccifera*	3.2	0.048	8.28	0.236	1.42	4.7	7.78
Orchis anatolica	40.55	35.72	24.30	Clayey-Loam	Limestone	*Quercus coccifera*	6.0	0.060	10.60	0.314	13.00	45.9	7.80
Orchis italica	38.56	19.80	41.64	Loam	Limestone	*Quercus coccifera*	2.0	0.060	7.62	0.310	1.70	830.0	7.71
Orchis pallens	57.89	10.46	31.64	Sandy-Loam	Schist	*Pinus nigra-Quercus coccifera*	1.6	<0.030	5.26	0.271	5.56	256.6	5.61
Ornithogalum nutans	45.51	15.82	38.66	Loam	Limestone	Fields	2.2	0.038	6.80	0.229	2.20	251.8	7.76
Ornithogalum umbellatum	82.00	8.00	10.00	Loamy-Sand	Neogene sediment	*Quercus coccifera*	1.0	<0.030	1.76	0.160	40.90	1330.0	6.10
Scilla bifolia	50.56	15.80	33.64	Loamy	Schist	*Astragalus* sp.	-	<0.030	2.40	0.314	12.00	45.9	6.92
Tulipa armena var. *lycica*	56.56	8.80	34.64	Sandy-Loam	Schist	*Cistus laurifolius*	1.5	<0.030	7.37	0.174	5.55	175.0	5.61
Tulipa sylvestris	48.56	23.80	27.64	Sandy-Loam	Pebble	*Pinus brutia*	36.0	0.065	4.36	0.188	1.90	202.7	7.83

Flowering time: April-June

Habitat: Macchie, phrygana, *Quercus* shrub, *Pinus* forest, often in moist places, on calcareous and schistose soil

C2 Denizli: PAU Campus area, 450 m. Endemic, Ir.-Tur.

Orchis anatolica Boiss.

Distribution: West and South Anatolia

Altitude: s.l.-1650 m.

Flowering time: March-May

Habitat: Macchie, shrub, *Pinus* forest

C2 Denizli: Karataş village (Cankurtaran), 780 m. E. Medit.

Orchis italica Poir.

Distribution: North-west, West and South Anatolia

Altitude: 50-700 m.

Flowering time: March-April

Habitat: Grassy places and macchie

C2 Denizli: PAU Campus area, 450 m.

Orchis pallens L.

Distribution: Mainly Outer Anatolia; rare in South and Inner Anatolia

Altitude: 1000-2400 m.

Flowering time: May

Habitat: Montane to subalpine meadows and forest glades

C2 Denizli: Sarhan Köyü, 450 m., Euro-Sib.

Discussion

As a result of the field studies, we determined 31 plants of which 5 had corms, 11 had bulbs and 15 had tubers. In general, the habitats of these species were above 1000 m.

According to its chemical properties, the soil in which the geophyte species are distributed is usually light alkaline. *Tulipa armena* Boiss. var. *lycica* (Baker) Marais, *Anemone coronaria* L. and *Orchis pallens* L. were on the acidic soils.

The soil samples include a good deal of phosphorus and are rich in potassium. The soil in which *Anemone coronaria* grows is rich in phosphorus and potassium, and the soil in which *Fritillaria pinardii* Boiss. grows is rich in nitrogen.

Tulipa armena var. *lycica* and *Orchis pallens* are found in acidic soils. Our samples were generally growing in sandy-loam texture soils, while the base rock is calcareous. *Quercus coccifera* L. is dominant in the habitats where the plant samples were observed (Table 1).

Hyacinthella lineata, *Fritillaria carica* subsp. *carica, Tulipa armena* var. *lycica, Ophrys phrygia, Corydalis wendelboi* subsp. *wendelboi* and *Cyclamen trochopteranthum* are endemic; the threat category to these species is considered to be lower risk (LR) and in addition, *Crocus baytopiorum* is considered to be vulnerable (VU).

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