ECOLOGICAL FEATURES OF *CENTAUREA* L. SECTION *PHALOLEPIS* (CASS.) DC. IN TURKEY

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Abstract. In this present study, the ecological characteristics of *Phalolepis* (Cass.) DC. a section of the *Centaurea* L. genus growing in Turkish was investigated. Important to note is that all species of the section are restricted endemics. Physico-chemical soil analyses as well as chemical analyses of different parts of the species were conducted. Soil and bedrock samples were investigated resuling in petrographic diagnoses. Discriminant analyses were used to determine the amount of the plant nutritional elements of the different plant parts such as root, stem, and leaf, depending on physical and chemical features of 0-10 cm soil specimens. The amount of the nutrient elements in the roots, stem and leaves, the classification success percentages were 92.3, 92.3 and 88.5, respectively. The discrimination analysis success percentage of the chemical and physical soil contents resulted in 96.2%.
Keywords: *ecology, Centaurea, soil, plant, analysis*

Introduction

Ecological areas are the result of geological, paleogeographic and historical factors where protected areas are determined based on endemic species (Olson and Dinerstein, 1998; Mittermaier et al., 1998; WWF and IUCN 1994-2001). Islands, mountains or isolated edaphic systems such as ultrabasic rocks, gypsum or limestone areas are generally classified as endemic plant areas (Favarger, 1972; Gomez-Campo et al., 1984). Widespread species become rare depending on the effects of humans on nature. Naturally rare and aquianted rare species are not distinguished easily (Rabinowitz et al, 1986; Gaston, 1994; Norton and De Lange, 1998). Restricted areas such as rocky slopes and cliffs are one of the major reasons for naturally rare plant species (Gaston, 1994). This kind of natural isolations and extreme habitats may lead to formations of local endemic and naturally rare plant species (Wyatt, 1997; Larson et al., 2000; Hopper, 2000). Geographical locations, ecological characteristics, paleogeography and historical features make Turkey rich for its flora. Although Turkey is about one fifth of Europe it has relatively more endemic plant species when compared. Approximately 30% of Turkish Flora is endemic, while all Europe consists about 2750 endemic plants (Ekim et al., 2000).

Globally around 700 *Centaurea* L. species are present in Asia, North Africa and America (Brummitt, 2004). The genus *Centaurea* is represented in Turkey by 34 sections, 226 species and the overall endemism rate is 66 % (Kültür, 2016). All of the *Phalolepis* section species are restricted endemic species, one of them is classified as NT (Near Threatened), 4 species are EN (ENdangered), and 4 species are CR (Critical Endangered) (IUCN, 2001).

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The main purpose of the study was to determine ecological features of the section *Phalolepis*.

Materials and Methods

Studied species were collected from their natural habitats between 2003-2005 (see *Table 1, Fig. 1*). Petrographic diagnoses were made both for soil and bedrock samples of plant species. Geological features of all section members were investigated by comparing Turkey geological map (1/500 000 scales), which was previously prepared by the Mineral Research and Exploration Institute (Duberted, 1973).

Plant samples of the root, stem and leaves were evaluated in detail, respectively. Chemical analyses were made by Semi-Micro Kjeldhal method for N (Jackson, 1962), Olsen method for P (Chapman and Pratt, 1961); Ca, Mg, K, ammonium-acetate; Na, sodium-acetate (Jackson, 1962); Fe, Cu, Zn and Mn wet digestion method (Walkley and Black, 1934). Also, 0-10 cm depth soil samples of the plants were collected from the areas, which were dried and color of the samples were compared with Standart Soil Color Charts (1970). Physical analyses of soils were made by Bouyoucus hydrometer method (1962), and soil types were determined using soil types utilizing triangle (Çepel, 1983). Chemical analyses of soils were made with Beckman and pH meter about 0,01 sensitivity (Jackson, 1962). Soil reaction was observed the in 1/2.5 ratio of suspension, the values of soil pH were compared with Kantarcı (2000). The amount of salt in the soil was determined by Conductance Bridge device (Jackson, 1962), and the results were compared with Eruz (1979). Amounts of $CaCO_3$ of soils were determined with Scheibler (Çepel, 1983), and the results were compared with Tüzüner (1990). Total N amounts of soils were determined by micro Kjeldahl Method (Jackson, 1962), and compared with Schröder (1972). Organic soil contents and Fe, Cu, Zn and Mn analyses were determined by the combustion method of Walkley and Black (1934). P amount was determined by Olsen method (Chapman and Pratt, 1961). Soil extracts were prepared for ammonium-acetate method (Jackson, 1962), and the results were evaluated comparing with Schröder (1972). Discrimination method was used for plant nutrient elements and soil types. Statistical analyses were performed using SPSS 10.0 software.

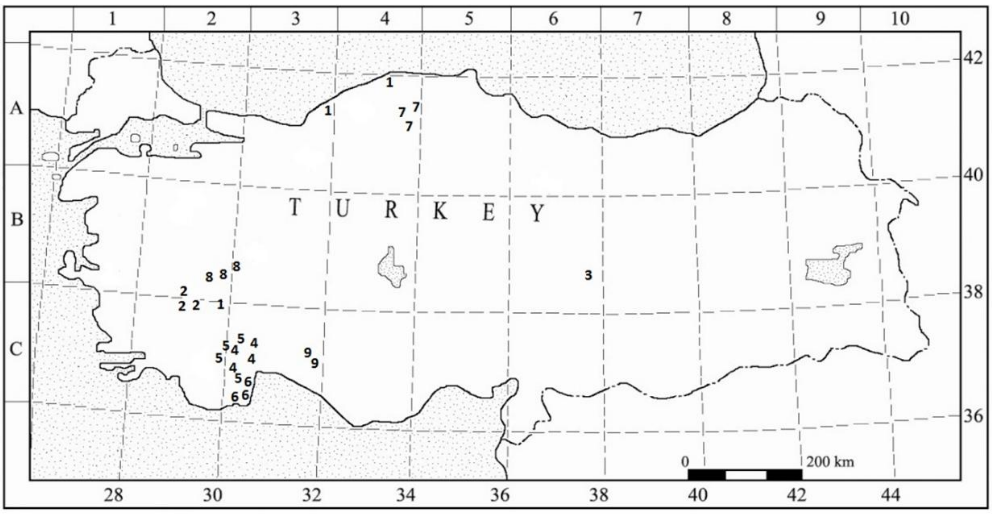

Figure 1. *Study fields*

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Table 1. *The localities of Phalolepis section*

	Species	Sample area	Locality
1	*C. cadmea*	1	Denizli: Honaz, National Park way, cliff, 804 m, 24 vi 2004, K 37^{o} 44’ 58.2”, D 29^{o} 16’ 07.3”
		2	Zonguldak: Devrek-Eğerci way, Yeşilöz village, cliff, 330 m, 19 vi 2004, K 41^{o} 05’ 42.4”, D 31^{o} 50’ 06.2”
		3	Bartın: Ulus, Ulukaya waterfall, cliff, 275 m., 6 ix 2005, K 41^{o} 40’ 07.4’’, D 32^{o} 45’ 59.8’’
2	*C. aphrodisea*	1	Aydın/Denizli: Geyre-Tavas way, rood side, rocky slopes, 1022 m, 25 vi 2004, K 37^{0} 39’ 53.0” D 28^{0} 51’ 52.7”
		2	İzmir: Ödemiş, Bozdağ, Ski center road, cliff, 1200 m, 25 vii 2004, K 38^{0} 21’ 07.8” D 28^{0} 05’ 19.6”
		3	Denizli: Başkarcı village, İsrail waterfall, Picnic area, rocky slopes, 933 m, K 37^{0} 55’ 42.6’’ D 29^{0} 08’ 07.4’’
3	*C. amaena*	1	Kayseri: Exit of Yılanlı mountain, rood side, cliff, 1194 m, 14 vii 2004, N 380 42’ 55.4” E 350 25’ 18.2”
4	*C. lycia*	1	Antalya: Antalya-Korkuteli way, 20. km, rood side, cliff, 538 m, 2 vi 2003, K 37^{0} 01’ 35.7” D 30^{0} 27’ 39.6”
		2	Antalya: Saklıkent way, 9 km before the plants, rocky slopes, 1142 m, 5 vii 2003
		3	Antalya: Kozdağı, Tahtalı resting place road, rocky slopes, 1130 m, 5 vii 2003, K 36^{0} 53’ 51.5” D 30^{0} 22’ 21.5”
		4	Burdur: Kızılkaya-Korkuteli way, Steep cliff, 844 m, 2 vii 2005, K 36^{0} 18’ 32.6’’ D 30^{0} 21’ 26.9’’
5	*C. luschaniana*	1	Antalya: Between Elmalı-Korkuteli, Karaman beli, cliff, 1300 m, 5 vii 2003, K 36^{0} 56’ 52.5” D 30^{0} 09’ 43.8”
		2	Antalya: Elmalı-Korkuteli way, rood side, limestone rocks, 1156 m, 4 vii 2003, K 36^{0} 45’ 09.6” D 29^{0} 54’ 22.6”
		3	Antalya: Between Korkuteli-Elmalı, 30. km, 1308 m, 4 vii 2003, K 36^{0} 56’ 37.7” D 30^{0} 07’ 04.4”
		4	Antalya: Between Korkuteli-Elmalı, 14. km, cliff, 1265 m, 3 vii 2005, K 36^{0} 58’ 17.3’’ D 30^{0} 09’ 05.7’’
6	*C. wagenitzii*	1	Antalya: Adrasan, Sazak way, under red pine, 18 m, 23 v 2004, K 36^{0} 18’ 52.4” D 30^{0} 28’ 00.0”
		2	Antalya: Adrasan, southwest of cost, walkways, *macchia*, 3 m, 9 vi 2004, K 36 ^{0} 17’ 53.8” D 30^{0} 28’ 25.6”
		3	Antalya: Adrasan, southwest slopes, *macchia*, 13 m, 3 vii 2005, K 36^{0} 17’ 54.1’’ D 30^{0} 28’ 26.5’’
7	*C. tossiensis*	1	Kastamonu: Between Tosya-Kastamonu, roodside, open forest area, 1048 m, 5 ix 2005, K 41^{0} 11’ 25.0’’ D 34^{0} 01’ 40.7’’
		2	Kastamonu: Daday, between Hasanağa-Çayözü, stony slope, 1035 m, 5 ix 2005, K 41^{0} 35’ 05.7’’ D 33^{0} 30’ 00.7’’
		3	Kastamonu: **between** Kastamonu-Araç, Ahlatçık village road, forest clearance, 1154 m, 6 ix 2005
8	*C. hieropolitana*	1	Afyon: Between Dazkırı-Çardak, Sarıkavak village, pond side, 974 m, 2 vii 2003, N 37 ^{0} 53’ 29.4” E 29^{0} 48’ 32.4”
		2	Denizli: Pamukkale, The front of travertine, 318 m, 24 vi 2004, N 37^{0} 55’ 20.4” E 29^{0} 07’ 00.7”
		3	Afyon: Exit of Dazkırı, steppe-*Peganum harmala* union, 870 m, 24 vi 2004, N 37^{0} 53’ 56.7” E 29^{0} 51’ 08.9”
9	*C. antalyense*	1	Antalya: Akseki, Güzelsu way, Serebel well side, under *P. brutia*, 1090 m, 6 vii 2003
		2	Antalya: Sadıklar-Güzelsu way, under *Cedrus*, 1077 m, 3 vii 2055, K 36^{0} 54’ 46.1’’ D 31^{0} 48’ 48.3’’

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Results and Discussion

Bedrock and Geology

Sample area of *C. cadmea* in Denizli-Honaz, bedrock is metamorphic schist while the geological structure is paleozoic; in Zonguldak-Devrek-Eğerci, main rock is andesite, the geological structure is Eocene, Paleocene, and Cretaceous; in Bartın-Ulus, bedrock is limestone and the geological structure is Cretaceous. Sample area of *C. aphrodisea* in Ödemiş-Bozdağ, bedrock is mica schist while the geological structure is paleozoic; in Aydin-Geyre, bedrock is mica schist, the geological structure is Neogene; in Denizli-Başkarcı, bedrock is crystallized limestone and the geological structure is paleozoic. Sample area of *C. amaena* in Kayseri-Yılanlı Mountain, bedrock is agglomerate and the geological structure is paleozoic. Sample areas of *C. lycia* in Antalya-Korkuteli road, Antalya-Kozdağı, Burdur-Kızılkaya and Antalya-Saklıkent main rocks are limestones and the geological structures are Mesozoic-tertiary in Antalya-Korkuteli road, Antalya-Kozdağı, and Antalya-Saklıkent. The geological structure of Burdur-Kızılkaya is Holocene. All sample areas of *C. luschaniana* main rocks are limestones, in Karaman beli, between Elmali-Korkuteli 30 km and 14 km geological structures are Holocene, and in the other locality geological structure is Miocene. In three localities of *C. wagenitzii* bedrocks are alluvial, and the geological structures are Quaternary. Sample area of *C. tossiensis* on rood side, bedrock is serpentine, the geological structure is Eocene; in Tosya bedrock is ultrabasic rocks, the geological structure is Neogene; in Daday bedrock is ultrabasic rocks and the geological structure is Cretaceous. Sample area of *C. hieropolitana* in Sarıkavak village between Dazkırı-Çardak main rock is marl, the geological structure is Oligocene; in the exit of Dazkırı bedrock is limestone, the geological structure is Quaternary; in Denizli-Pamukkale bedrock is travertine and the geological structure is paleozoic. Sample areas of *C. antalyense* in Güzelsu-Serebel well side and Sadıklar-Güzelsu way both two localities have limestone bedrocks and upper Cretaceous as the geological structures.

Plant Analysis

The amounts of nutrient elements of plants roots are seen in *Table 2*. The highest amount of N have been found 3.1351% and is seen on the second sample area of *C. cadmea*. The lowest one is 0.3327% and is seen on the fourth sample area of *C. luschaniana.* The highest Mg rate (10250 ppm) is seen on the first sample area of *C. aphrodisea* and the highest Zn amount (419.5 ppm) is seen on the first sample area of *C. luschaniana*.

The amounts of nutrient elements of the plants stems has given in *Table 3*. The analyses show the stems have lower N amounts than the roots. A third sample area of *C. wagenitzii*, second sample area of *C. tossiensis* and third sample area of *C. hieropolitana* stems have higher N rates than the roots. A third sample area of *C. wagenitzii* has the highest Na (1300 ppm), third sample area of *C. cadmea* has the highest Fe (2500 ppm), first sample area of *C. lycia* has the highest Cu (125.5 ppm) rates.

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Table 2. *The nutrient elements of species roots*

Species	Locality	N %	Na ppm	Mg ppm	Ca ppm	Fe ppm	K ppm	Mn ppm	Zn ppm	Cu ppm	P ppm
C. cadmea	1	1,0603	400	1715	31795	2130	15000	167,5	39	30	1550
	2	3,1351	450	1555	14525	1430	11000	398,5	71	29,5	550
	3	1,0564	700	1595	29760	2310	15250	140,5	31,5	31,5	1650
C. aphrodisea	1	1,3938	225	10250	9500	2970	6250	152	38	15,5	525
	2	1,8704	575	1335	8680	1080	13500	96,5	10,5	11	450
	3	0,7167	450	1635	25620	1920	7000	209	57	18	700
C. amaena	1	1,4651	350	1185	21450	445	8000	77	71	30	950
C. lycia	1	2,0476	1500	1250	17590	445	15000	43,5	90	33,5	1550
	2	1,1029	575	1175	4740	680	7250	82	72,5	20	1050
	3	1,4509	625	1010	7915	215	10500	14	72	9	900
	4	1,2018	625	2130	22805	3995	11000	154,5	37	20,5	1300
C. luschaniana	1	1,1653	775	1780	13495	2025	10500	113,5	419,5	37	1250
	2	0,8293	600	940	8675	980	8750	90	84	44	700
	3	0,969	350	995	14485	1335	6250	91	80,5	56,5	950
	4	0,3327	575	1135	15300	520	8750	42,5	18,5	13,5	450
C. wagenitzii	1	2,0484	875	6695	16535	1520	7000	74	174	22	2100
	2	0,3576	550	1455	3750	900	5000	22	31	14,5	200
	3	0,6382	775	1155	2865	330	6250	8,5	20,5	10	525
C. tossiensis	1	0,9056	350	1310	9250	350	13000	38	26,5	15	2350
	2	0,4396	275	1450	8455	235	12500	20	16,5	9	1000
	3	0,5862	350	1305	10640	585	11750	79,5	37,5	16,5	1100
C. hieropolitana	1	0,9151	1050	1470	9380	500	10000	21,5	69,5	11	250
	2	1,2687	400	6550	35005	500	14500	31	68,5	13	750
	3	1,592	1175	1795	16575	1035	9500	39	53,5	6,5	525
C. antalyense	1	1,0647	675	1435	12850	1870	19500	85,5	176	33,5	1850
	2	0,8107	500	1080	10400	1290	10000	56	29	26,5	1350

Table 3. *The nutrient elements of species stems*

Species	Locality	N %	Na ppm	Mg ppm	Ca ppm	Fe ppm	K ppm	Mn ppm	Zn ppm	Cu ppm	P ppm
C. cadmea	1	1,0048	275	1215	13150	445	10500	24	17,5	9,5	1600
	2	1,1763	300	1040	8230	270	14500	106,5	19	9	750
	3	0,5922	450	1340	18875	2510	7250	74,5	27,5	12	1600
C. aphrodisea	1	0,9026	500	1435	11590	210	9250	15	18,5	5,5	1000
	2	0,9808	300	1100	9420	755	12000	36,5	10	6,5	250
	3	0,5566	500	930	6560	160	9500	20,5	24,5	10	700
C. amaena	1	1,1115	200	1005	11915	145	14500	23	24,5	9	1250
C. lycia	1	1,6296	625	1320	15790	365	10500	25	101	125,5	1200
	2	1,4202	200	1155	4790	375	6500	18,5	83,5	11,5	300
	3	1,5348	275	1350	14070	280	14000	9,5	63,5	12,5	750
	4	0,7383	550	1980	22700	515	8500	22	16,5	7	950
C. luschaniana	1	0,984	325	1265	11850	505	8750	28,5	181,5	42,5	1100
	2	0,6869	475	1145	11835	385	7000	29	75,5	30,5	700
	3	0,7157	250	755	7525	280	5500	15,5	93	23	650
	4	0,325	175	2330	16875	210	5250	13,5	20	5,5	600
C. wagenitzii	1	1,6964	350	1340	12790	575	8000	30,5	177	17	1050
	2	0,5554	800	2360	5715	135	6250	15,5	19,5	10,5	450
	3	0,4	1300	1800	4890	185	7000	13	12,5	9,5	525
C. tossiensis	1	0,9855	450	1515	14515	275	12000	20,5	24,5	9	2950
	2	0,646	250	1380	14590	75	10500	7	12,5	8	1350
	3	0,8832	125	1435	10315	310	11250	37	33,5	12,5	1350
C. hieropolitana	1	0,7041	700	2230	11620	145	11250	9,5	50	10	700
	2	1,1337	300	6150	32445	200	7000	29	39,5	10,5	550
	3	1,6449	250	2180	24905	240	4750	17	31	7	950
C. antalyense	1	0,746	325	1090	8010	95	18250	4,5	109,5	15	850
	2	0,5797	400	620	5275	75	17250	3	18,5	8,5	1650

Table 4 shows the amount of nutrient elements in the leaves of the species. Almost all the elements are the greater amount of the leaves than the roots and stems. In second

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and third sample areas of *C. wagenitzii* have the highest Na (1650-2000 ppm), and third sample area has the highest Mg (14 305 ppm) rates.

Table 4. *The nutrient elements of species leaves*

Species	Locality	N %	Na ppm	Mg ppm	Ca ppm	Fe ppm	K ppm	Mn ppm	Zn ppm	Cu ppm	P ppm
C. cadmea	1	2,0169	300	3910	31270	1290	23000	65	37,5	21,5	2100
	2	2,3444	225	1840	17170	1110	16500	237	39,5	19	1700
	3	1,1191	350	1800	17505	2940	20750	94,5	46	26	4450
C. aphrodisea	1	1,3833	175	2655	25140	650	12500	37	26	7,5	700
	2	2,2592	325	3395	25045	3880	15250	107,5	33	14,5	750
	3	1,1414	450	1600	16635	545	11000	43,5	45	22	950
C. amaena	1	1,9419	225	1915	28095	480	15750	51	55	11,5	1470
C. lycia	1	2,2657	450	2310	36200	2700	8750	113,5	107	114,5	1300
	2	1,4619	500	2610	11205	3165	6500	118	93,5	44	500
	3	2,8814	450	2515	37405	3725	13750	104	70	49	1300
	4	1,5095	575	3860	34610	1230	10000	56	26,5	10,5	1050
C. luschaniana	1	1,4243	275	1330	17055	915	8750	55	58,5	22,5	950
	2	1,1122	375	1365	16480	855	10000	61,5	40	20	1050
	3	1,3064	250	1725	22455	2250	11000	91,5	74,5	51,5	1100
	4	0,4922	325	5800	35340	1490	5750	52	28,5	10	600
C. wagenitzii	1	2,4083	625	7300	23070	1280	7750	96	68	71	600
	2	0,9655	1650	6655	7135	445	9250	25,5	25	20	350
	3	0,6426	2000	14305	9890	1260	8000	45,5	23,5	19,5	400
C. tossiensis	1	2,6647	175	1855	22550	1805	15250	86,5	41	15	3000
	2	0,9985	225	1265	16210	160	13500	14,5	19,5	9,5	1250
	3	1,8141	225	6300	21430	2615	17000	172,5	53	29,5	1750
C. hieropolitana	1	1,5874	450	2480	23890	465	15000	26	34,5	10	750
	2	1,8227	275	7450	38015	265	9500	50,5	38,5	14	1000
	3	2,6221	325	3895	27080	295	8750	25	34	12,5	1900
C. antalyense	1	1,7396	350	2115	29230	490	24750	35	89	38,5	1900
	2	1,0479	700	1955	30165	4845	22000	147	40	17	1450

Physical Analysis of Soils

C. cadmea prefers sandy-slime type soil, two sample areas of *C. aphrodisea* is sandy-slime type soils and another sample area is slimy sand (*Table 5*). *C. amaena* is found in sandy-slime soil; slimy-clay, slimy sand, sandy-slime, slime types soils have been observed in localities *of C. lycia,* has large soil type tolerance.

Table 5. *The physical properties of the soils in the localities of species*

Species r	Locality	Structure of Soil			Soil Type	Color of Soil	
		Sand %	Clay %	Dust %		Dry	Wet
C. cadmea	1	79,33	10,62	10,05	Sandy- slime	2,5 Y – 6/2	2,5 Y – 3/2
	2	84,9	6,23	8,82	Sandy- slime	2,5 Y – 4/2	5 YR – 1,7/1
	3	72,4	13,44	14,16	Sandy- slime	10 YR – 6/4	10 YR – 4/4
C. aphrodisea	1	76,39	14,61	9	Sandy- slime	10 YR – 5/4	5 YR – 2/2
	2	89	4,2	6,8	Slimy-sand	10 YR – 6/4	5 YR – 2/2
	3	74	13,3	12,7	Sandy- slime	5 YR – 4/3	10 R – 2/3
C. amena	1	70,9	12,8	16,3	Sandy- slime	7,5 YR-5/3	5 YR-2/4
C. lycia	1	41,17	41,08	17,75	Slimy-clay	5 YR – 5/4	5 YR – 3/6
	2	86,31	7,5	6,18	Slimy-sand	2,5 Y – 5/3	10 YR – 3/2
	3	76,04	9,55	14,41	Sandy- slime	5 YR - 4/2	5 YR – 2/2

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	4	48,91	13,21	37,87	Slime	7,5 YR - 4/3	7,5 YR – 3/3
C. luschaniana	1	56,02	38,95	5,03	Sandy-clay	7,5 YR – 5/4	2,5 YR – 2/4
	2	31,23	38,51	30,25	Slimy-clay	5 YR – 5/6	2,5 YR – 3/4
	3	41,47	32,35	26,17	Slimy-clay	5 YR – 4/4	2,5 YR – 2/4
	4	43,75	33,57	22,68	Slimy-clay	7,5 YR – 6/6	7,5 YR – 5/8
C. wagenitzii	1	42,57	47,12	10,31	Slimy-clay	5 YR – 3/6	7,5 R – 3/6
	2	71,2	18,86	9,93	Sandy- slime	5 YR – 4/8	10 R – 3/4
	3	59,71	25,45	14,84	Sandy-clay	5 YR – 4/6	5 YR – 3/6
C. tossiensis	1	87,91	4,03	8,06	Slimy-sand	10 YR – 5/2	10 YR – 3/1
	2	48,58	39,08	12,34	Slimy-clay	10 YR – 5/3	10 YR – 3/4
	3	72,46	15,17	12,37	Sandy-clay Slime	10 YR – 5/3	10 YR – 4/4
C. hieropolitana	1	64,24	19,54	16,22	Sandy-clay Slime	10 YR – 6/3	5 YR – 4/3
	2	40,52	8,89	50,6	Dusty-slime	2,5 Y – 8/2	10 YR – 7/2
	3	69,54	15,53	14,93	Sandy-clay Slime	2,5 Y – 7/3	7,5 YR – 4/3
C. antalyense	1	41,46	34,48	24,06	Slimy-clay	10 YR – 3/3	10 YR – 2/2
	2	38,82	38,19	22,98	Slimy-clay	7,5 YR – 4/3	7,5 YR – 3/4

Soil types of distribution areas of *C. luscahaniana* are 75% of slimy-clay and 25% sandy clay. *C. wagenitzii* prefers slimy-clay, sandy-slime, and sandy clay type soils. *C. tossiensis* distributes in slimy-sand, slimy-clay, and sandy clay-loam type soils. Two sample areas of *C. hieropolitana* are sandy clay-loam type soils and in the other locality, soil type is dusty slime. Soil type of both two localities of *C. anatlyense* is slimy-clay.

Soil type rates of *Phalolepis* section are 30.7% of sandy-slime, 30.7% of slimy-clay, 11.6%, of slimy-sand, 11.6% of sandy clay-loam, 7.8% of sandy-clay, 3.8% of slime and 3.8% of dusty-slime.

Chemical analysis of soils

Table 6 shows the chemical properties of the soils in the distribution areas of the species. *C. cadmea* spreads in slightly acidic and alkaline soil has large tolerance on the amount of $CaCO_3$. Besides, first sample area of *C. cadmea* has the high rate of P_2O_5. *C. aphrodisia* prefers neutral and lightly alkaline soil like *C. cadmea* has tolerance to the $CaCO_3$. Soil type of distribution area of *C. amaena* is neutral and without lime. *C. lycia* and *C. luschaniana* grow in limestone main rocks, they prefer high lime and alkaline soils. An also fourth sample area of *C. lycia* has the high rate of K. *C. wagenitzii* grows in lightly alkaline soils and localities of the species have the high rate of Mg. *C. tossiensis* has a high tolerance for the soil type, prefers without lime or low lime soils.

C. hieropolitana grows on marl, lime, travertine bedrock so prefers alkaline and lime soils. *C. antalyense* prefers neutral, low amounts of lime soils, in the present study first sample area has the high rate of organic compounds.

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Table 6. *The chemical properties of soils in the area of distribution of species*

Species	Locality	pH 1/2,5	Salt ms/cm	Lime %	Organic %	N %	Na ppm	Mg ppm	Ca ppm	Fe ppm	K ppm	Mn ppm	Zn ppm	Cu ppm	P_2O_5 ppm
C. cadmea	1	8,32	0,47	0,45	1,15	0,0186	15	47	3285	1,2	70	6,2	1,01	0,71	82,82
	2	6,52	0,32	0	2,49	0,0497	30	73	946	1,1	51	10,3	1,01	0,2	16,16
	3	8,64	0,3	55,9	0	0,0489	30	70	7049	0,4	71	6,8	1,11	0,3	5,05
C. aphrodisea	1	7,95	0,37	0	0,98	0,028	21	1751	1569	1,4	93	4,8	0,82	0,21	5,15
	2	7,45	0,28	0,15	0,4	0,0113	25	191	1546	1,1	56	5,9	1,31	0,4	16,16
	3	8,59	0,24	44,5	0	0,047	21	2470	6586	1,3	101	0,7	0,74	0,42	37,1
C. amena	1	7,36	0,47	0	2,87	0,0578	31	190	3005	1,1	296	7,2	4,18	0,82	74,46
C. lycia	1	8,26	0,41	44,5	2,02	0,2045	51	204	7781	0,6	416	9,4	1,13	0,93	18,54
	2	8,09	0,34	0,9	0	0,0644	52	331	5673	0,4	98	6	1,13	0,62	21,63
	3	7,98	0,44	39,2	1,33	0,3746	21	334	7631	1,2	165	3,2	0,93	0,62	18,54
	4	8,21	0,72	25	11,33	0,5546	74	366	7917	1,7	1525	15,2	0,84	8,51	18,9
C. luschaniana	1	8,23	0,29	6,96	12,07	0,4188	37	581	8175	0,6	783	1,3	1,07	0,75	24,61
	2	8,39	0,26	13,04	2,59	0,2657	37	296	8055	0,9	411	3,3	0,74	0,74	22,05
	3	8,22	0,3	10,1	3,66	0,3265	53	262	8140	0,8	318	2,3	0,95	0,74	19,08
	4	8,64	0,4	54,4	0,93	0,036	31	427	7381	0,5	258	0,7	0,72	10,61	27,81
C. wagenitzii	1	8,1	0,11	0	1,08	0,0201	251	3019	1745	0,5	238	10,2	1,16	0,65	6,45
	2	7,94	0,36	0	0,58	0,0098	85	2360	746	0,3	97	6,6	0,91	0,34	5,7
	3	8,22	0,81	0	0,28	0,0371	334	2639	1310	0,7	138	15,8	0,74	0,21	11,66
C. tossiensis	1	8,43	0,43	5,84	1,8	0,0693	25	137	6420	1	55	22,1	1,14	0,61	5,05
	2	6,25	0,2	0	0,27	0,1156	36	244	1265	0,8	98	10,7	1,01	0,62	23,69
	3	8,41	0,36	2,71	0,99	0,0789	26	112	7434	0,8	82	3,5	1,55	0,52	5,15
C. hieropolitana	1	8,22	0,39	28,4	1,27	0,177	25	215	6923	0,8	304	0,9	1,01	0,61	23,23
	2	8,68	0,49	71,9	1,59	0,0419	21	214	7150	1,4	57	1,4	0,94	0,73	21,84
	3	8,35	0,53	29,8	1,67	0,0223	32	147	7239	0,6	171	3,7	1,5	0,64	32,1
C. antalyense	1	7,45	0,13	2,19	12,95	0,7206	69	248	8000	1,8	297	16	1,38	1,17	9,54
	2	7,65	0,58	0,5	1,92	0,1943	47	207	6259	1,2	287	5,6	1,35	0,62	16,64

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Statistical Analysis

In the analyses of the amount of the nutrient elements of the roots, the classification success have been found 92.3%. One sample area of *C. aphrodisea* passed to *C. lycia*, one sample area of *C. luschaniana* passed to *C. wagenitzii*, other plant species stayed in their own groups (*Fig. 2*). First, two discrimination functions include 71,8 % of all variance. In separation analyses of amounts of the nutrient elements of the roots, in the first function Mn, P, Ca and N are the most important variants, and in the second function Ca, Mn, Zn, and P (*Table 7*).

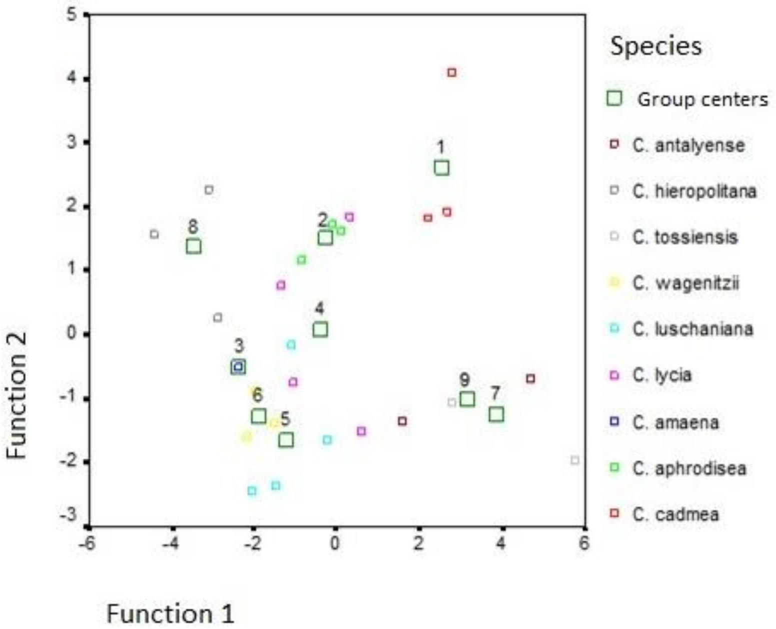

Figure 2. *The graphical representation of the discriminant analysis of amount of nutrient element analyses of roots*

The classification analysis success of amounts of nutrient elements of the stems is 92.3%. One sample area of *C. cadmea* passed to *C. tossiensis,* one sample area of *C. hieropolitana* passed to *C. lycia,* other plant species stayed in their own groups (*Fig. 3).* First, two functions of *Table 8* explain the 77,1% of the variations. In separation analyses of amounts of the nutrient elements of the stems, in the first function Na, N, P, and Cu are the most important variants, and in the second function N, Zn, Fe, and K.

Table 7*. The results of discrimination of amount of nutrient elements of the roots*

Function	Core value	Variance (%)	Total (%)	Kanon. Korelas	Wilks' Lambda	Khi-Kare	SD	Severity level
1	8,408	51,7	51,7	,945	,001	102,391	80	,047
2	3,279	20,1	71,8	,875	,013	67,646	63	,322
3	2,471	15,2	87,0	,844	,054	45,113	48	,592
4	,754	4,6	91,6	,656	,189	25,823	35	,871
5	,611	3,8	95,4	,616	,332	17,113	24	,844
6	,550	3,4	98,7	,596	,534	9,720	15	,837
7	,190	1,2	99,9	,400	,828	2,925	8	,939
8	,015	,1	100,0	,120	,986	,225	3	,973

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Standardized Separation Function Coefficients

	Function							
	1	2	3	4	5	6	7	8
N %	-1,103	,339	,113	-1,010	,605	-,523	-1,063	,009
Na ppm	-,418	,329	-,329	,547	,417	,280	,961	,063
Mg ppm	,003	,197	-,470	,886	-,510	,314	,383	,740
Ca ppm	-1,201	,626	,416	-,740	-,288	,016	,130	,125
Fe ppm	-,361	,147	,085	,246	,883	-,243	-,950	-,166
K ppm	1,099	,409	,039	,298	,003	,849	-,258	-,008
Mn ppm	1,457	,599	-,017	,676	-,470	-,080	1,078	-,116
Zn ppm	-,660	-,530	,365	,009	-,268	,243	-,054	-,164
Cu ppm	-,106	-,347	,892	,179	,093	,130	-,018	,307
P ppm	1,431	-,504	-,595	-,324	,212	-,507	,497	,346

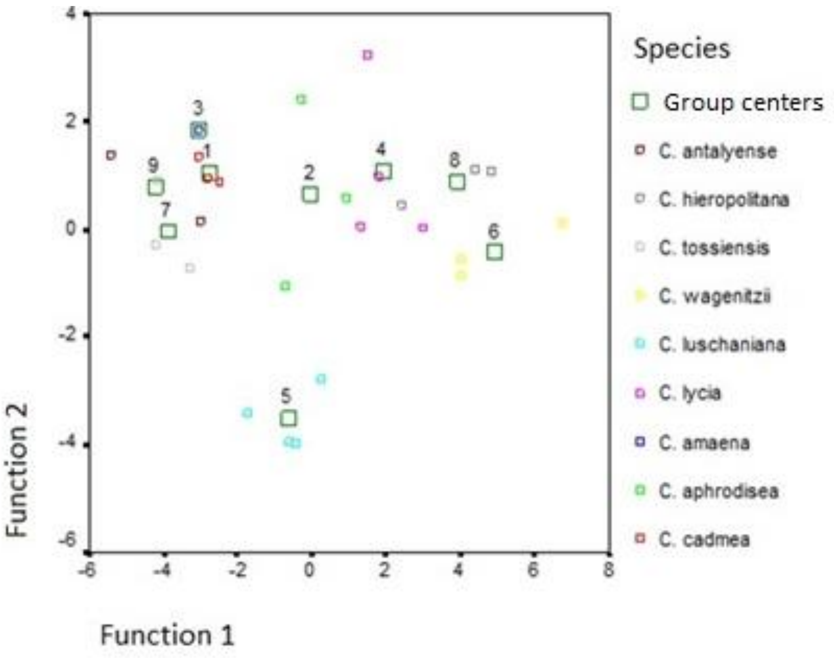

Figure 3. *The graphical representation of the discriminant analysis of amount of nutrient element analyses of stems*

Table 8. *The discriminate analysis results of amount of nutrient element analyses of stems*

Function	Core value	Variance (%)	Total (%)	Kanon. Korelas	Wilks' Lambda	Khi-Kare	SD	Severity level
1	14,596	60,8	60,8	,967	,000	118,585	80	,003
2	3,927	16,3	77,1	,893	,007	76,006	63	,126
3	2,652	11,0	88,2	,852	,037	51,289	48	,346
4	1,198	5,0	93,1	,738	,133	31,213	35	,652
5	1,096	4,6	97,7	,723	,293	19,004	24	,752
6	,359	1,5	99,2	,514	,615	7,534	15	,941
7	,173	,7	99,9	,384	,836	2,785	8	,947
8	,020	,1	100,0	,140	,980	,307	3	,959

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Standardized Separation Function Coefficients

	Function							
	1	2	3	4	5	6	7	8
N %	1,764	1,565	,217	,031	-,016	-,553	,054	-,243
Na ppm	1,834	,444	,144	,602	,123	,082	,225	-,191
Mg ppm	,486	,433	,040	,199	,835	,151	,142	,614
Ca ppm	,160	-,244	-,294	-,844	-,368	,518	,106	-,501
Fe ppm	,060	,873	,059	,303	-,445	,127	,177	,772
K ppm	-,648	,789	-,598	,164	-,118	,420	,172	,006
Mn ppm	-,425	-,337	,969	,010	,051	,257	,106	-,410
Zn ppm	,336	-1,271	-,320	,345	,270	,532	,591	-,432
Cu ppm	-,649	-,184	-,227	-,480	-,534	-,405	,272	,607
P ppm	-1,017	-,137	,431	,128	,865	-,438	,269	,070

The classification analysis success of amounts of nutrient elements of the leaves have been found 88.5%. One sample area of *C. aphrodisea* passed to *C. luschaniana*, one sample area of *C. luschaniana* and *C. hieropolitana* passed to *C. aphrodisea*, other plant species stayed in their own groups (*Fig. 4*).

First, two separation functions explain the 85,3% of all variations. In the first function Mn, N, K and Cu, in the second function Zn, Cu, Ca and Mg have provided the biggest contribution (*Table 9*).

The discrimination analysis success of chemical and physical soil (0-10 cm) contents of the species is 96.2%. One sample area of *C. hieropolitana* passed to *C. lycia*, other plant species stayed in their own groups (*Fig. 5*).

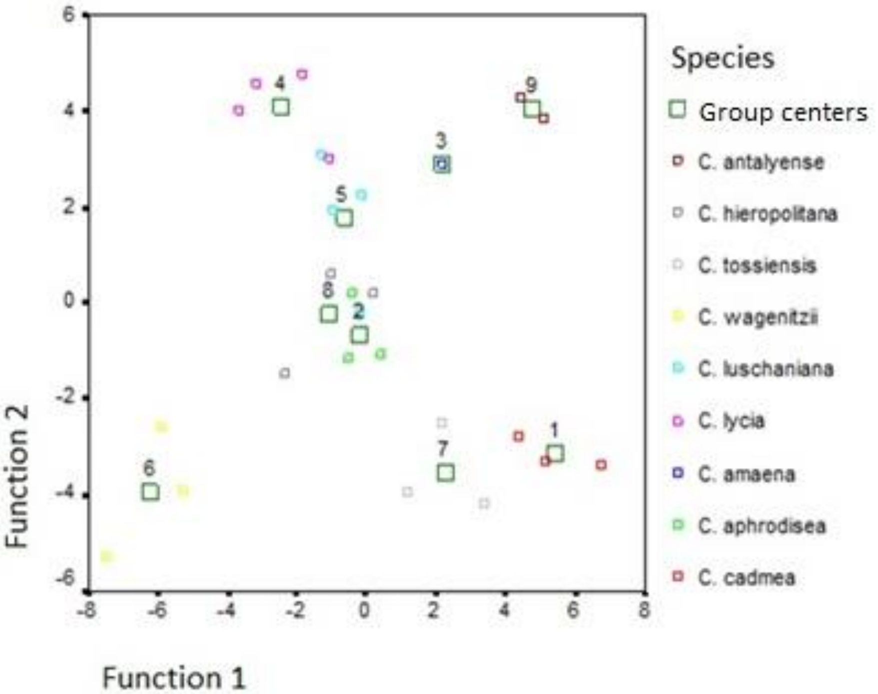

***Figure 4.** The graphical representation of the discriminant analysis of amount of nutrient element analyses of leaves*

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Table 9. *The discriminate analysis results of amount of nutrient element analyses of leaves*

Function	Core value	Variance (%)	Total(%)	Kanon. Korelas	Wilks' Lambda	Khi-Kare	SD	Severity level
1	17,631	47,7	47,7	,973	,000	133,598	80	,000
2	13,893	37,6	85,3	,966	,003	88,264	63	,020
3	3,488	9,4	94,8	,882	,050	46,400	48	,539
4	,821	2,2	97,0	,671	,225	23,127	35	,938
5	,698	1,9	98,9	,641	,410	13,838	24	,950
6	,331	,9	99,8	,499	,695	5,634	15	,985
7	,044	,1	99,9	,204	,925	1,200	8	,997
8	,035	,1	100,0	,185	,966	,540	3	,910

Standardized Separation Function Coefficients

	Function							
	1	2	3	4	5	6	7	8
N %	-1,026	-,756	-,010	,684	,215	,899	,275	-,305
Na ppm	-,640	1,342	1,297	,193	,415	-,119	-,283	-,486
Mg ppm	-,297	-1,766	-,199	,212	-,212	-,074	,398	,739
Ca ppm	,315	2,504	,537	,364	,559	-,275	-,705	,076
Fe ppm	-,620	,311	-,510	-,412	-,570	,751	,264	,532
K ppm	,923	-,519	,459	,096	-,493	,134	,008	,058
Mn ppm	1,177	,240	,610	-,341	,715	-,462	-,378	-,594
Zn ppm	,276	3,350	,655	,683	,262	-,696	1,032	-,033
Cu ppm	-,739	-2,700	-,039	-1,064	-,222	,513	-,606	,326
P ppm	,654	-,332	,123	-,065	,831	-,276	,061	,211

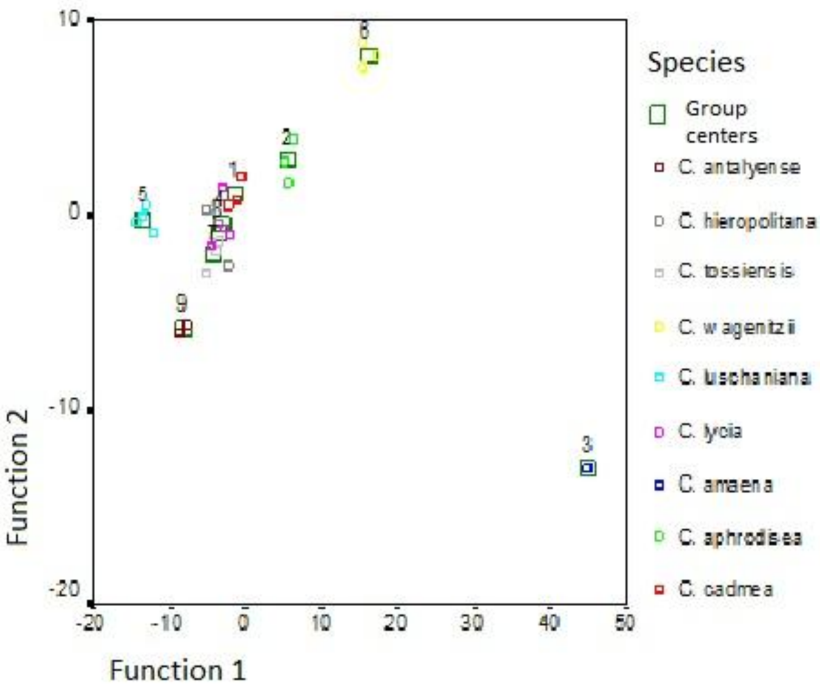

Figure 5. *The graphical representation of the discriminant analysis of chemical and physical properties of the soils (0-10 cm) of the distribution localities of the species*

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First, two separation functions explain the 92,4% of all variations. In the first function Ca^{++}, N, the organic compound, and Zn^{++}, in the second function Ca^{++}, pH, sand and K amounts are important (*Table 10*).

Table 10. *The discriminate analysis results of chemical and physical properties of the soils (0-10 cm) of the distribution localities of the species*

Function	Core value	Variance (%)	Total(%)	Kanon. Korelas	Wilks' Lambda	Khi-Kare	SD	Severity level
1	227,09	82,0	82,0	,998	,000	194,444	128	,000
2	28,653	10,4	92,4	,983	,000	126,572	105	,075
3	13,331	4,8	97,2	,964	,001	84,202	84	,473
4	4,121	1,5	98,7	,897	,017	50,922	65	,899
5	1,635	,6	99,3	,788	,087	30,505	48	,977
6	1,063	,4	99,7	,718	,230	18,394	33	,981
7	,563	,2	99,9	,600	,474	9,344	20	,979
8	,351	,1	100,0	,510	,740	3,762	9	,926

Standardized Separation Function Coefficients

	Function							
	1	2	3	4	5	6	7	8
pH	2,652	1,691	,088	,043	-,326	,323	-,488	,807
Salt	-,060	-,822	-1,109	-,166	-,021	,023	,700	,007
Lime	2,823	,508	1,788	,688	,043	,188	,539	,547
Dust	1,913	,441	-,954	1,552	-,010	-,495	,282	-,748
Sand	2,334	,942	1,156	1,073	,466	,055	,109	-,288
Org. comp.	-3,724	,004	-,614	,141	-1,787	-1,107	,229	,204
N	3,976	,400	-1,523	,643	1,132	1,045	,089	1,082
Na^{+}	-,033	,826	,322	,496	-,100	-,089	,186	,252
Mg^{++}	2,409	,121	-,827	-,314	,051	,219	,074	-,414
Ca^{++}	-5,822	-2,083	-,480	-,491	,207	-,234	,189	-1,191
Fe^{++}	-,739	-,744	1,847	-1,637	-,465	,510	,187	,230
K^{+}	2,098	,932	2,160	,702	,831	,740	-,352	-,441
Mn^{++}	1,003	-,421	-,164	-,313	,904	-,616	-,040	-,117
Zn^{++}	3,232	-,855	-,260	-,054	-,006	,128	-,001	-,057
Cu^{++}	-1,042	-,507	-1,096	-,379	,060	,256	-,579	,041
P_2O_5	,481	-,178	,133	,830	,075	-,238	-,240	,342

Conclusion

Because of limited distribution areas, population of these species are under risk of being extinct. Having narrow habitat let species in *Phalolepis* section be damaged by any natural or antropogenic activity. Tourism activities (Saklıkent, Termessos), agriculture, road construction, grazing and building activities in the region are the most dangerous activities for future of these species populations. Conservation strategies must be performed immediately for species.

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