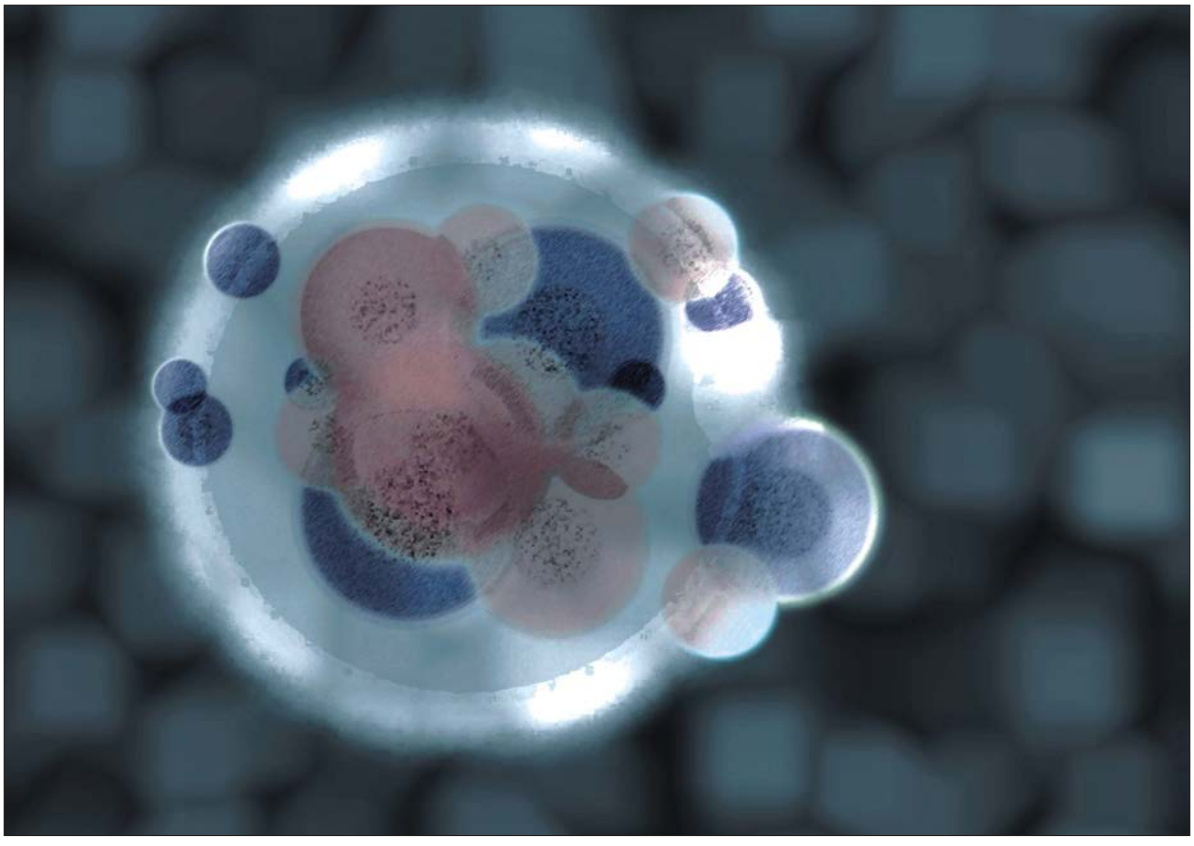

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Autoecological and Morphological Features of *Astragalus stenosemioides* D.F. Chamb and V.A. Matthews

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Abstract: Autoecological and conservation aspects of the *Astragalus stenosemioides* D.F. Chamb and V.A. Matthews are discussed by studying the morphological and palynological studies. *A. stenosemioides* is a threatened, very local endemic species to Erciyes Mountain. Erciyes Mountain (3917 m) is volcanic mountain in the inner Anatolia part of Turkey. The rocky type is andezit and volcanic tufa and the soil is andezit and tufa without limestone. For this reason Erciyes Mountain, is one of the important floristic areas in Turkey. With regards to genetic resources, this area is of major importance for *in situ* conservation of plant genetic diversity. The data gained from field studies were evaluated according to IUCN categories (Criteria B1 B2) and the Critically Endangered (CR) status has been proposed for the species. It was determined that it grows in three small areas in the mountain where *A. stenosemioides* populations are under heavy grazing stress.

Key words: *Astragalus stenosemioides*, morphology, palynology, autoecology, conservation

INTRODUCTION

Geological, paleogeographic and historical factors have helped to create highly diverse environments. One of the most important criteria used in the identification of high-priority areas for conservation is endemism[1,2]. Thus, the insular mountain or isolated edaphic systems (ultra basic rocks, gypsum, limestone, etc.) generally appear to be major endemic centres[3].

Turkey has an extremely rich flora due to its geographical location, ecological properties, paleogeography and vegetation history. Although, Turkey has one fifteenth of total land covered by European countries, it has an overwhelming number of endemic species. The records show that the European countries other than Turkey possess 12,000 species of which 2750 are endemic. In Turkey, the number of species was estimated as 10,000 of which 30% are endemic[4,5].

Astragalus L. is the genus containing the highest number of species among the spermatophytes. While exact number has not been established yet, it is estimated to be around 2500[6]. Almost all of the species distributed throughout the old world are found in Iran, Turkey and Central Asian countries. Six hundred species from Iran and 450 species from Turkey have been recorded so far. It is apparent that Turkey is one of the most important centers of distribution of the genus. As a result, *Astragalus* is listed among the genera of high endemism rate, with a value of 51.29 % in Turkey[6-9].

Erciyes Mountain which is a situated in South of Kayseri, is a huge volcanic mountain, with approximate altitude (4000 m). In prehistory, it is known that dense forests covered in Erciyes Mountain but nowadays mountainous steppe plant communities are to take the place of these forests because of dense cutting and grazing. This area is including rich flora as to 840 taxa in spite of big change in natural plant community. It is to be located 130 endemic to Turkey and approximately 42 taxa which is become rare in level country. It is nine taxa in area which is unique to Erciyes Mountain (*Astragalus argaeus* Boiss., *A. leptothamnus* Bunge, *A. stenosemioides* D.F. Chamb and V.A. Matthews, *Asyneuma trichostegium* (Boiss.) Bornm., *Erigeron zederbaueri* Vierh., *Hieracium subvandasii* (Bornm and Zahn) Sell and West, *Onobrychis argaea* Boiss and Balansa, *Silene argaea* Fisch and Mey.). In this study, species of *Astragalus stenosemioides* D.F. Chamb and V.A. Matthews which is showing to spread only here in the world and entering under risk to disappear with the excessive grazing, is studied to determine the features of morphological, palynological, autoecological and conversation.

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MATERIALS AND METHODS

The specimens were examined and the measurements were made using light microscope and micrometer or ruler. Also, some features of the specimens were obtained in the field. The pollen grains were obtained from dried herbarium specimens. Several unopened buds (to make sure alien pollen grains were not present) were placed in a watch glass and squashed adding a few drops of wetting agent. The pollen grains were transferred to copper stubs, which were already prepared with double-sided adhesive tape and then stubs were coated with gold for 5-6 min for studying and taking pictures in SEM. A jeol 100xCXII scanning electron microscope was used in the study. The terminology used is mainly that of Punt *et al.*[10]. Soil specimens (0-30 cm deep) were collected from each site and brought into the laboratory for analysis (Table 1). The analyses were carried out according to Walkley and Black[11], Jackson[12], Chapmann and Pratt[13], Bouyoucus[14] and Olsen and Sommers[15].

RESULTS

Morphological description: *Astragalus stenosemioides* D.F. Chamb and V.A. Matthews, Notes Roy. Bot. Gard. Edinburgh 29: 303, 1969.

Holotype: Turkey, B5 Kayseri, Cappadocia, mt. Argaei (Erciyas Da.), 2700-3000 m, 18.6.1890, *J.F.N. Bornmüller 1637* (BM; iso: B!, BR, K!, W!).

Plants acaulescent, 2-4(-5) cm, covered with equally to unequally bifurcate hairs. Caudex strongly branched. Stems absent. Stipules membranous, green to yellowish-green, 5-10 mm, narrowly triangular to triangular, adnate to the petiole for 2-3 mm, otherwise free from each other, at the margin and apex sparsely addressed white-hairs, otherwise glabrous or sometimes sparsely hairy only at the base. Leaves 1-3 cm; petiole 0.4-1 cm, white-hairy. Leaflets 5-8-paired, folded or somewhat flat, 3-6x1-2.5 mm, narrowly elliptic or narrowly obovate to elliptic, acute to obtuse at the apex, white-hairy on both sides. Peduncle 1-3 cm, densely covered in lower part with addressed white, in upper part with predominantly black hairs. Raceme globose to shortly oblong, 15-25-flowered, 1.5-2x1-1.5 cm. Bracts membranous, yellowish-white with greenish tip, narrowly triangular, 5-8 mm, with sparse to dense black and white hairs, soon glabrescent. Bracteoles absent or two, c. 2 mm, hairy. Calyx yellowish-greenish, 6-7 mm, tubular, densely covered with ± addressed black and white or sometimes only white hairs; teeth linear, green, 3-4 mm, densely covered with long black (towards the base also white) hairs, on inner surface glabrescent.

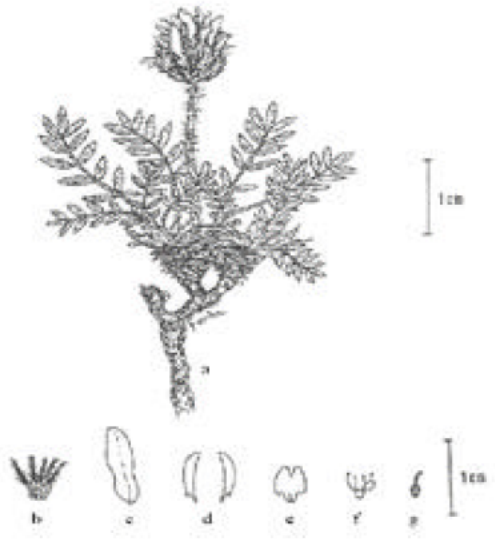

Fig. 1: *Astragalus stenosemioides* a. Habitus, b. Calyx, c. Standard, d.Wings, e. Keel, f. Stamens, g. Ovary

Petals purplish-pink. Standard 9-12x2-3 mm, oblong-pandurate, obtuse to acute at the apex, slightly constricted in the middle, without clearly differentiated claw, only slightly narrowed at the base. Wings 6-8 mm, blades narrowly oblong, acute at the apex, 5-7x1-1.5 mm, auricle c. 0.3 mm, claw 1-1.5 mm. Keel 4-5 mm, blades oblong-elliptic, acute at the apex, 3-4x1-1.5 mm, auricle minute, c. 0.2 mm, claw 1-1.5 mm. Stamens 3 mm, the upper 1 mm free. Ovary subsessile, white hairy, style hairy only at the base. Fruits unknown (Fig. 1)[16].

Flowering time: May-June.

Habitat: Steppe, stony places; 2200-3000 m.

Specimens seen:
[B5]: Kayseri: mt. Argaei (Erciyas mt.), 2450 m, 18.6.1934, Balls 1418 (E, K) - ibid., 2300-2400 m, 24.6.1998, M. Ekici 2104 and H. Akan, S. Celik (GAZI, MSB).

Distribution: Endemic. Irano-Turanian element.

This is very local endemic species growing only on Erciyes mountain in Kayseri province and at a low population density. Because of extreme grazing pressure no fruiting specimens have been collected during three years of study. Therefore, the future of this species will remain under threat unless conservation measures are taken.

Status: Known only from type locality. Nearly a hundred mature specimens of the new species were observed in

area and its occupancy is less than 10 km^2. The data gained from field studies were evaluated according to IUCN categories (Criteria B1, B2) and the Critically Endangered (CR) status has been proposed for the species[17].

Pollen characteristic: Pollen grains are tricolporate. Polar axis (P)27.83 μm, equatorial axis (E) 20.02 μm, P/E 1,39, prolate. The ornamentation is reticulate. Pollen grains are tectate. The shape of porus, Plg/Plt:0.88, suboblate. Colpus is narrow and long, edges are slightly apparent, Clg/Clt: 4.71.

ECOLOGY AND CONSERVATION

Erciyes Mountain is a volcanic mountain between Kayseri and Develi and it is high about 3917 m. The mountain was active in Miyosen and Kuva-terner geologic period, nowadays it is an inactive volcano. In mountain, which is approximate 35 km in wideness andezit is found and volcanic tufa rocks in big level together small basalt rocks in west point in geologic structure. The mountain has sharp rocks and usually cover with snow, the other parts has productive soil from soft andezit and tufa and it causes to a rich flora. Plant community of Erciyes Mountain is become mountain steppe communities in big level. Characteristic plant community is steppe community which becomes *Astragalus microcephalus* Willd. in low part (between 1200 and 1500 m which becomes slim of soil thick in areas). This communities leave it's place to *Astragalus pycnocephalus* Fischer var. *pycnocephalus* communities especially increase of erosion levels in part and between 1500 and 1650 m. It is seen that plant communities which usually belong to *Gramineae* family in cushion form between 1650 and 1800 m in mountain. *Astragalus acmophyllus* Bunge and *Acantholimon venustum* Boiss. var. *venustum* are dominant according to the steppe community in cushion form in more above (1800-2150 m). *Astragalus angustifolius* Lam., *Daphne oleoides* Schreber, *Erysimum alpestre* Kotschy ex Boiss and *Phlomis linearis* Boiss and Balansa can be counted between characteristic taxa which is found in this plant community.

Erciyes Mountain, is one the important floristic areas in Turkey. With regards to genetic resources, this area is of major importance for *in situ* conservation of plant genetic diversity. In the present study, information about the habitat, demography and biological relationships of the species are presented. It is thought that this study will help in building up effective conservation programs.

Astragalus stenosemioides populations are located between 2300 and 2400 m altitudes. Population I grows in 2110 m on the north slopes of 30 degree inclination with 15% coverage in a 250 m^2 area, population II is found in 2300 m on the southwest slopes of 30 degree inclination with 30% coverage in 500 m^2 area and population III is on the same side with population II in 2375 m on the field of 30 degree inclination with 20% coverage in 300 m^2 area[18,19].

Table 1: Soil analysis of *Astragalus stenosemioides* populations (0-30 cm)

	Populations		
Characteristics	I	II	III
pH	7.90	8.00	7.90
$CaCO_3$%total	4.90	5.50	5.00
Organic Mat.%	3.60	3.80	3.50
P_2O_5%	95.00	60.00	60.00
N%	0.86	0.75	0.65
Ca^{++}ppm	11750.00	13500.00	9850.00
Mg^{++}ppm	2250.00	24000.00	2650.00
K^+ppm	9000.00	8000.00	7500.00
Na^+ppm	60.00	50.00	70.00

Astragalus stenosemioides grows on the volcanic calcerous main mass. The soil in calcerous areas is moderately basic. The soil in which *Astragalus stenosemioides* grows is rich in $CaCO_3$ and organic matter content, but poor in nitrogen (Table 1). In the distribution areas of *Astragalus stenosemioides* Mg^{++} and K^+ ions are in normal levels, but Na^+ ions are under the limits.

Astragalus stenosemioides is not dominant species in three locations and associated with *Dianthus zederbaueri* Vierh., *Saponaria viscosa* C.A. Meyer, *Silene lasiantha* Koch, *Astragalus acmophyllus* Bunge, *Astragalus gummifer* Labill, *Oxytropis persica* Boiss., *Onobrychis argaea* Boiss and Balansa, *Asperula capitellata* Hausskn and Bornm. ex Bornm., *Logfia gallica* (L.) Coss and Germ, *Tanacetum parthenium* (L.) Schultz, *Sonchus asper* (L.) Hill. subsp. *glaucescens* (Jordan) Ball., *Veronica kotschyana* Bentham, *Trisetum rigidum* (Bieb.) Roem and Schult in distribution area.

DISCUSSION

The impact of humans on natural ecosystems has resulted in the formation of a new suite of rare species that were previously more abundant but are now rare because of human and animal disturbances. The Red Data Book listings of the IUCN include many rare species[5] *Astragalus stenosemioides* is a perennial endemic species. The pollen grain is tricolporate. Andezit and volcanic tufa rocks in the soil of surrounding areas make the habitat of *Astragalus stenosemioides* to be very local. The study showed that *Astragalus stenosemioides* is very tolerant of cold temperatures, but very sensitive to drought. Another aspect which might affect the survival of the species in the area is gene flow among three populations. As a result of chemical analyses of the

soil it was found that it is rich in $CaCO_3$ and organic matter content, but poor in nitrogen and sodium and normal level in calcium.

Population size of a plant, variations in its morphology and number of seed production are mostly affected by genetic changes during time, existence of predators and ecological factors[20-24]. Also, skitourism, plateau tourism and ecotourism became a serious danger for the populations. Little animals are the only livelihood for local farmers, because of the steep slopes. It was detected that there is a serious goat grazing in the area. These small animals feeds especially on the flowers and basal leaves of *Astragalus stenosemioides*, but while feeding they damage the young capitula and so decrease the seed production.

Much more detailed studies on the effects of wind and ants in dispersal of the seeds of *Astragalus stenosemioides* will be investigated in a long period. It was determined that *Astragalus stenosemioides* might be thought as an indicator species for andezit and volcanic tufa soils main mass. To complete *in situ* activities very few seeds were collected from three populations and preserved in the Biology Department (Gazi and Çanakkale Onsekiz Mart Universities). Collection of the seeds will carry on during a long period without damaging the populations. At the same time, the studies on germination of the seeds and vegetative propagation are still going on. A technique for producing this species might help in saving also the other natural populations under a variety of stresses and in propagation of well desired plants. Visitors collect the attractive flowers of the species without knowing its rarity. *Astragalus stenosemioides* is under a threat of being extinct because of its limited distribution area and small population size. It was seen in our prolong observations that this species is under very high threat and its populations are limited to 300-500 m^2 areas in three localities. Therefore it should be put in critically endangered category (CR). Also about this and the other rare species of Erciyes Mountain, conferences and meetings must be carried out by local governess to inform the people. The farmers must be leaded to feed their animals especially on the east and south slopes with abundant grass rather than where the endemic rare plants grow.

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