

ARAŞTIRMA MAKALESİ / RESEARCH ARTICLE

NEW SYNTAXA FROM STEPPE VEGETATION IN CAPPADOCIA, TURKEY

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ABSTRACT

This study comprises syntaxonomical analysis of the vegetation spread out in the eastern part of Cappadocia where the dry and cold variants of Mediterranean climate prevails. In the area, a new alliance *Convolvulo assyrici – Helianthemion cani* was created by clustering of the quadrates carried out on calcareous and marly soils, and attached to the order *Onobrychido armenae – Thymetalia leucostomi* of the class *Astragalo microcephali – Brometea tomentelli* in which most of the steppe vegetation of Anatolian territory was included.

Kelimeler: Phytosociology, Syntaxonomy, Steppe, Central Anatolia, Turkey.

**KAPADOKYA YÖRESİNDE (TÜRKİYE) STEP VEJETASYONUNA AİT YENİ
SENTAKSONLAR**

ÖZ

Bu çalışma Kapadokya'nın doğusunda bulunan kurak ve soğuk Akdeniz ikliminin etkisi altındaki vejetasyonun sintaksonomik analizini içermektedir. Alanda, Anadolu'da yayılış gösteren step vejetasyonunun çoğunun dahil olduğu *Onobrychido armenae – Thymetalia leucostomi* ordosunun *Astragalo microcephali – Brometea tomentelli* sınıfına bağlı kalkerli ve marnlı topraklar üzerinde gelişen yeni alyans *Convolvulo assyrici – Helianthemion cani* kuartatların kümelenmesi ile oluşturulmuştur.

Keywords: Fitososyoloji, Sintaksonumi, Step, İç Anadolu, Türkiye.

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1. INTRODUCTION

In the study, it was aimed to determine the synecological and syntaxonomical characteristics of calcareous and marly steppes among the towns Sarkisla, Kangal and Gurun (Sivas province) in the eastern part of Central Anatolia.

The studies on the vegetation in Turkey were, so far, particularly focused on the sylvatic vegetation while the herbaceous ones have a broad geographical distribution (Akman, 1974; Cetik, 1963, 1965; Krause, 1940; Louis, 1939; Yaltirik et al., 1983, Walter, 1962).

Steppe in Turkey is of importance, due to its anthropogenic characteristics, in Inner Anatolian sub region of Irano-Turanian floristic area Zohary (1973). Today the heavy and permanent anthropogenic pressure on this type of vegetation decreases its distributional area and makes it restricted in patches. The floristic composition of the steppe vegetation in Anatolia varies in short distances due to the alternation of edaphic characteristics originated from different main rocks.

In contrast to sylvatic vegetation, less attention was paid on steppes of Anatolian territory. The present phytosociological data on the steppes in Turkey were recently obtained (Quézel, 1973; Ketenoglu et al., 1983, 1996; Akman et al., 1984, 1985, 1996; Akman, 1990; Aydogdu et al., 1999). The steppes of eastern and upper Mesopotamian part of Turkey are also deficiently known from the phytosociological point of view (Gumus, 1992; Behcet, 1994).

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The Anatolian steppe can be classified in two main groups as calcicole and gypsicole ones. The recent attention paid on the gypsicole vegetation in Central Anatolia created an opportunity to form an alliance *Astragalo karamasici* – *Gypsophilion eriocalycis* Ketenoglu, Quézel, Akman and Aydogdu 1983 and three sub alliances (Ketenoglu et al., 1983, 2000). These are the first higher units described above association level on steppe vegetation in Anatolia.

A new alliance was added to the calcareous and marly steppic groups in Anatolia through the study at hand and some lack of the information on this type of vegetation was tried to be depleted. After the completion of the data on the steppes in other parts of Anatolia, the position of

the present syntaxa and their synchorology will be detailed in clear. This study is one of the successive works on the steppe vegetation that will contribute to the similar researches in Turkey and its adjacent geography.

2. MATERIALS AND METHODS

For the analysis of the vegetation was followed the traditional Braun-Blanquet approach (1964) and used the modified scale of Barkman, Doing and Segal (1964) for the combined valuation of abundance and cover. 30 quadrates were taken. The quadrates were clustered by polar ordination techniques Bray, Curtis (1957). The sizes of the quadrates were estimated by means of “minimal area” which was 60 m². The ecological data were placed at the top of each quadrate forming phytosociological tables. Association tables were made by grouping in one table all quadrates of identical or very similar floristic composition. Thus, the associations in the study area were differentiated by means of floristic and structural examination. The floristic composition and structure of plant associations exhibiting a certain physiognomy, was established and they were identified and classified by the aid of characteristic and differential species. International code of phytosociological nomenclature principles was followed for naming the new syntaxa (Weber et al., 2000). Moreover, to categorise the syntaxa correctly, relevant literatures were used (Quézel, 1973, Quézel et al., 1992, Akman et al., 1985).

3. RESULTS

3.1. Brief Description of The Area

The study area is located between the towns Sarkisla, Kangal and Gurun (Sivas) in the east part of Central Anatolia (Fig. 1). In the area, the brown coloured soils are widespread (Baykal and Erentoz, 1966).

The altitudinal range of the area varies between 1300 and 1700 m. The climate of the region in which the steppe vegetation is dominant is characterised by cold winters, often with frost, and hot summers with drought periods. That indicates the prevalence of semi arid and cold variants of Mediterranean climate. The steppe vegetation developing under xeric conditions is characterised by xerophytic species of Irano-Turanian origin. The data of the meteorological stations of Sarkisla, Kangal and Gurun were used to determine the type of the climate in the region (Table 1).

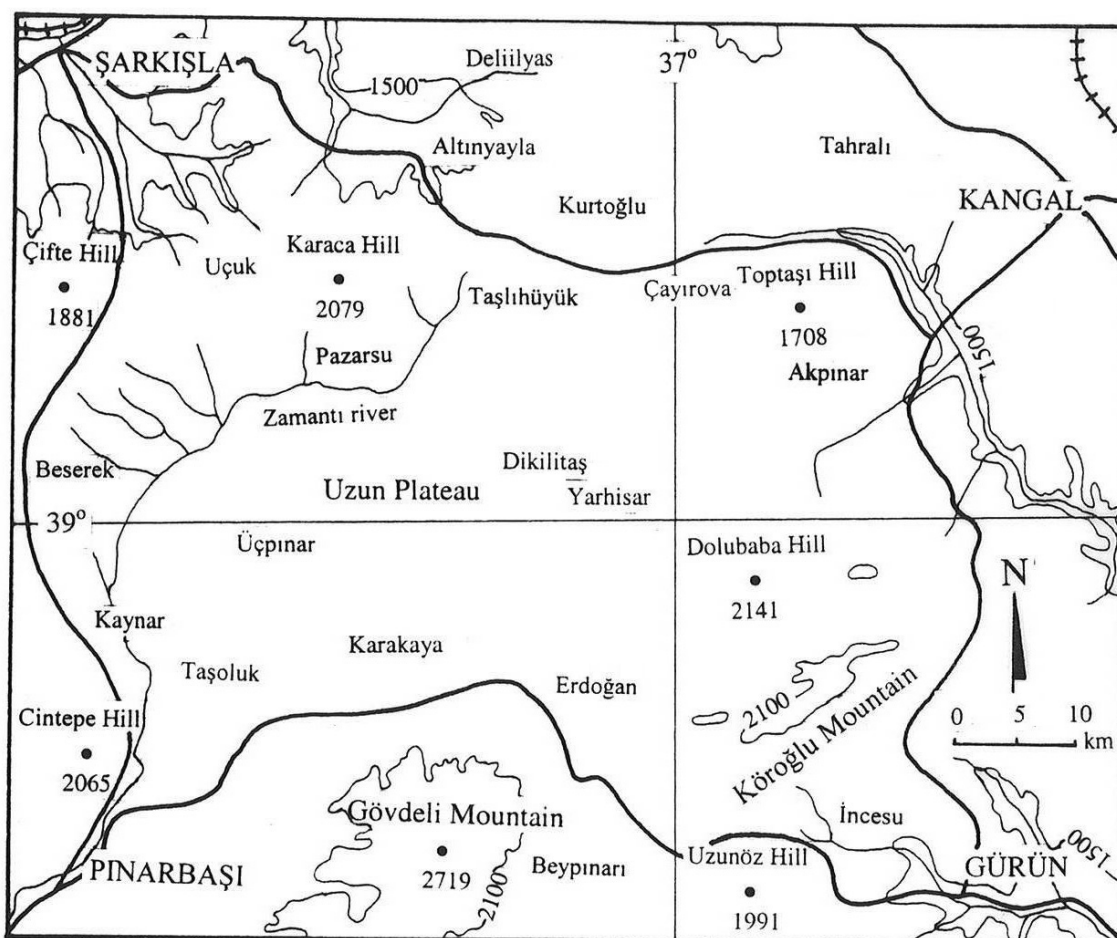


Figure 1: Map of the study area.

Table 1. Climatic data of the Sarkisla, Kangal and Gurun meteorological stations.

Stations	Altitude (m)	P (mm)	M (°C)	m (°C)	Q	PE	S	Precipitation regime	Variants of Mediterranean Bioclimatic
Sarkisla	1180	495	27.5	-9.9	50	65	2.3	SP-W-A-S	Semi-arid upper extremely cold
Kangal	1545	478	26.6	-9.5	47	50	1.8	SP-W-A-S	Semi-arid upper extremely cold
Gurun	1250	319	29.9	-5.1	32	29	0.9	SP-W-A-S	Semi-arid lower very cold

P (mm): Mean annual precipitation

M (°C): Mean maximum for the hottest month

m (°C): Mean minimum for the coldest month

Q: Emberger's pluviometric quotient ($2000.P / M^2 - m^2$)

PE : Summer rainfall

S: Emberger's index of xericity ($S=PE / M$)

W: Winter, SP: Spring, S: Summer, A: Autumn

The meteorological station of Gurun has semi-arid lower very cold type of Mediterranean climate that is common in Central Anatolia. While Sarkisla and Kangal are under the effective control of extremely cold, upper semiarid variant of Mediterranean type, particularly predominant in eastern Anatolia Akman (1982). Bioclimatic data show that the study area is situated in a transitional zone effected with two variants of Mediterranean climate prevail in East and Central Anatolia.

3.2 Classification of the Vegetation

The study area is situated in the Irano-Turanian phytogeographical region Zohary (1973), with altitudes 1300-1700 m, character

ised by the cushion-forming chamaephytes and xerophytic species. We classified the steppe vegetation in one alliance and three associations included in the *Onobrychido armenae-Thymetalia leucostomi* Akman, Ketenoğlu & Quézel 1985 order. The associations described here have formed a new alliance which has been considered in the following syntaxa:

ALLIANCE: *CONVOLVULO ASSYRICI - HELIANTHEMION CANI* ALL. NOVA,

(Type association: *Asperulo capitellatae-Salvietum caespitosae*)

The plant cover represents an alliance composed of three associations well-developed on the soils originating from calcareous mother rock in the study area. This alliance extends between the towns of Sarkisla, Kangal and Gurun (Sivas). It occupies the area with an elevation of 1300-1700 m. In the area occupied by the alliance, the two variants of semiarid Mediterranean climate are predominant; upper extremely cold and lower very cold.

Due to its floristic composition, the alliance was included in class *Astragalo microcephali-Brometae tomentelli* Quézel 1973, which was formed to include the peculiar communities of spiny xerophytes, and its order *Onobrychido armenae-Thymetalia leucostomi* Akman, Ketenoğlu & Quézel 1985 comprising most of the steppe formations in Central Anatolia.

The characteristic species of the alliance are *Helianthemum canum* (L.) Baumg., *Ebenus laguroides* Boiss. var. *laguroides*, *Hypericum thymopsis* Boiss., *Convolvulus assyricus* Griseb., *Convolvulus compactus* Boiss., *Linum*

flavum L. ssp. *scabrinerve* (Davis) Davis, *Galium incanum* Sm. ssp. *pseudocornigerum* Ehrend., *Stipa capillata* L., *Minuartia anatolica* (Boiss.) Woronow ssp. *scleranthoides* (Boiss. & Noë) McNeill, *Asphodeline tenuior* (Fisch.) Ledeb. ssp. *tenuiflora* (K.Koch) E.Tuzlaci var. *puberulenta* E.Tuzlaci.

Three associations of the alliance;

ASSOCIATION: *ACANTHOLIMO VENUSTI - ASTRAGALETUM NOEANI* ASS.NOVA,

(Holotype: Table 2, Quadrate no: 4)

This association occupies west, Southwest and Southeast slopes with an inclination of 20°–40° and an altitude of 1300-1650 m. It has a structure composed of spiny cushion-forming and tuft-forming xerophytes with a height of 5-40 cm. The coverage of the species is about 80-90 %. The dominant species of the association are *Astragalus noeanus* Boiss., which is the characteristic species, and *Thymus sipyleus* Boiss. ssp. *rosulans* (Borbás) Jalas. Other diagnostic species are *Acantholimon venustum* Boiss. var. *venustum*, *Astragalus lagurus* Willd. and *Achillea gonioccephala* Boiss. & Bal.. The association has a distribution around town of Sarkisla.

ASSOCIATION: *STACHYO LAVANDULIFOLIAE - CONVOLVULETUM LINEATI* ASS.NOVA, (Holotype: Table 2, Quadrate no: 19)

This association has a structure composed of chamaephytes and hemicryptophytes with a height 5-50 cm. The coverage of the species is about 85-90 %. This association is fairly characterised by the presence of *Convolvulus lineatus* L., which is a chamaephyte within the association with coverage of 40-60 %. Other characteristic species are *Stachys lavandulifolia* Vahl. var. *lavandulifolia*, *Stipa lessingiana* Trin & Rupr. and *Hedysarum pogonocarpum* Boiss. This association has a limited distribution on the east and Northeast slopes between towns of Kangal and Gurun. It occupies the slopes with an inclination 20° – 30° and altitude of 1500-1650 m.

ASSOCIATION: *ASPERULO CAPITELLATAE-SALVIETUM CAESPITOSAE* ASS. NOVA, (Holotype: Table2, Quadrate no:15)

It is type association of alliance. This association is characterized by the presence of *Salvia caespitosa* Montbret & Aucher ex Bentham, which is the dominant species, *Asperula capitellata* Hausskn. & Bornm. ex Bornm. *Genista albidula* Willd., and *Thymus parnassicus* Hal. and occurs on north and Northeast slopes with an inclination of 5° or plain areas and with an altitude of 1500-1700 m. The association spreads around the towns of Kangal and Gurun. It has a structure particularly composed of chamaephytes with a height of 5-25 cm. The coverage of the species is about 95-100 %.

4. CONCLUSION

The study area which is located within the east part of Central Anatolia is confined to the Irano-Turanian floristic province from phytogeographical point of view (Zohary, 1973). The soil type is derived from mainly calcareous material. The semi-arid upper extremely cold and lower very cold types of Mediterranean climate are effective in the area occupied generally by steppe vegetation adapted to xeric conditions in Central Anatolia. The associations described here have been considered within the syntaxa in the light of the latest works.

Synopsis of the syntaxonomical units dealt with in the text is as follows:

Superclass: *Daphno oleoidis-Festucetales variaie* Quézel 1964

Class: *Astragalo microcephali-Brometea tomentelli* Quézel 1973

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

Suborder: *Onobrychido armenae-Thymenetalia leucostomi* Akman, Quézel, Barbéro, Ketenoglu & Aydogdu 1991

Alliance: *Convolvulo assyrici-Helianthemion cani* all. Nova

Association: *Acantholimo venusti-Astragaletum noeani* ass. Nova

Association: *Stachyo lavandulifoliae-Convolvuletum lineati* ass. Nova

Association: *Asperulo capitellatae-Salvietum caespitosae* ass. nova (type ass.)

The communities described here are gathered in the superclass *Daphno oleoidis-Festucetales variaie* composed of two classes one of which is *Daphno oleoidis-Festucetea variaie* Quézel 1964 including the echorche meadows of some south-east Mediterranean countries such as Albania, Yugoslavia, Bulgaria and Greece and the other one described on the Taurus Mountain in Anatolia *Astragalo microcephali-Brometea tomentelli* Quézel 1973.

The class, *Astragalo microcephali-Brometea tomentelli* is composed of communities of cushion-forming spiny xerophytes and chamaephytes. In Central Anatolia, this class is represented by the order *Onobrychido armenae-Thymetalia leucostomi* comprising the steppic groups. The steppe associations described here have been considered in the alliance *Convolvulo assyrici-Helianthemion cani* nova attached to the suborder *Onobrychido armenae-Thymenetalia leucostomi*.

This alliance is composed of the communities formed by calcifuge species and spread on the calcareous-marly soils on the peaks above 1500 meters in the eastern part of Central Anatolia, and can be thought to be an eastern vicariants of the communities *Helianthemetea annua* (Br.-Bl., 1952) Rivas-Goday 1957 described by the calcifuge ephemeroxytes in Mediterranean Europe.

At the lower altitudes, the skirts of the mountains in the region have often been occupied by the gypsaceous species on the soils derived from gypsaceous materials. Same gypsaceous species from the alliance *Astragalo karamasici-Gypsophilium eriocalycis* Ketenoglu, Quézel, Akman & Aydogdu 1983 therefore, penetrate to these calcicole groups at higher elevations as transgressive component. But their abundance and coverage are quite poor.

Exposure, elevation and inclination are the major effective impacts on distribution of the associations attached to the alliance. While the association *Acantholimo venusti-Astragaletum noeani* nova prefers the areas with an inclination 20° – 40° on the west or Southwest slopes of 1300-1650 meters, *Stachyo lavandulifoliae-Convolvuletum lineati* nova occupies the east and Northeast slopes of 1500-1650 meters with the same inclination as previous one. The last one *Asperulo capitellatae-Salvietum caespitosae* nova spreads on the north and Northeast slopes

with an inclination of 0°–5° at the same altitudes. This association has an coverage 95-100 %.

Although all the associations described here show a homogenous physionomy, they have quite heterogeneous floristic composition due to the anthropogenic impact on them. *Asperulo capitellatae-Salvietum caespitosae* nova was chosen as type association of the alliance due to the fact that its diagnostic species have been represented better than in the others.

As compared, the floristic compositions of the associations within the alliance with the adjacent communities in the region, there have been a weak affinity and a poor similarity between them except for some gypsicole species penetrating from the lower altitudes.

REFERENCES

- Akman, Y. (1974). Etude phytoecologique de la region de Beypazari-Karaçar et Nallihan. *Comm. Fac. Sci. Univ. Ankara* 18 (C), 52-113.
- Akman, Y. (1982). Climats et bioclimats mediterraneens en Turquie. *Ecol. Medit.* VIII (1,2), 73-87.
- Akman, Y. (1990). Etude de la végétation stepique des montagnes d'Aydos située au Nord-Ouest d'Ankara. *Ecol. Medit.* XVI, 223-230.
- Akman, Y., Ketenoglu, O. & Quézel P. (1985). A new syntaxon from Central Anatolia. *Ecol. Medit.* XI (2/3), 111-121.
- Akman, Y., Ketenoglu, O., Quézel, P. & Demirors, M. (1984). A syntaxonomic study of steppe vegetation in Central Anatolia. *Phytocoenologia* 12 (4), 563-584.
- Akman, Y., Quézel, P., Barbero, M., Ketenoglu, O. & Aydogdu, M. (1991). La vegetation des steppes, pelouses écorchées et à xérophytes épineux de l'Antitaurus dans la partie sud-ouest de l'Anatolie. *Phytocoenologia* 19 (3), 391-428.
- Akman, Y., Vural, M., Quézel, P., Kurt, L., Ketenoglu, O., Serin, M. & Barbero, M. (1996). Etude de la vegetation stepique de la region de Karaman et d'Ermenek (sud de l'Anatolie Centrale). *Ecol. Medit.* XXII (3/4), 1-7.
- Aydogdu, M., Ketenoglu, O. & Hamzaoglu, E. (1999). New syntaxa from Cappadocia (Kirsehir, Turkey). *Israel J. Plant Sciences.* 47, 123-129.
- Barkman, J.J., Doing, H. & Segal, S. (1964). Kritische Bemerkungen und Vorschläge zur quantitativen Vegetationsanalyse. *Acta Bot. Neerl.* 13, 394-419.
- Baykal, F. & Erentoz, C. (1962). *1/500.000 ölçekli Türkiye Jeoloji Haritasi-Sivas Paftasi*. MTA Yayinlari. Ankara.
- Behcet, L. (1994). Hizan (Bitlis) vejetasyonu. *Turk J. Bot.* 18, 289-303.
- Braun-Blanquet, J. (1964). *Pflanzensoziologie, Grundzüge der Vegetationskunde*. 3. Aufl. Wien, New York.
- Bray, J.R. & Curtis, J.T. (1957). An ordination of the Upland Forest Communities of Southern Wisconsin. *Ecol. Monogr.* 27, 325-349.
- Cetik, R. (1963). The vegetation of Cubuk Dam. *I.Ü. Fen Fak. Mec.* Seri B (3-4), 109-138.
- Cetik, R. (1965). A study on the range vegetation of Lalahan Zootekni Institute, Polatli and Altinova Devlet Uretim Ciftlikleri. *Comm. Fac. Sci. Univ. Ankara* 9 (C), 35-61.
- Gumus, I. (1992). Tahir Daglari ve Guzeldere Havzasi (Agri) step vejetasyonunun bitki sosyolojisi yönünden arastirilmesi. *DOGA Turk J. Bot.* 16, 153-175.
- Ketenoglu, O., Aydogdu, M., Kurt, L., Akman, Y. & Hamzaoglu, E. (2000). Syntaxonomic research on the gypsicole vegetation in Cappadocia, Turkey. *Israel J. Plant Sciences* 48, 121-128.
- Ketenoglu, O., Kurt, L., Akman, Y. & Serin, M. (1996). A new alliance from Central Anatolia, "Minuartion juniperinopetalozzae". *Turk J. Bot.* 20, 457-464.

- Ketenoglu, O., Quézel, P., Akman, Y. & Aydogdu, M. (1983). New syntaxa on the gypsaceous formations in the Central Anatolia. *Ecol. Medit.* IX (3/4), 211-221.
- Krause, K. (1940). Bati ve Orta Anadolu nebat formasyonlari (Ceviri: Hikmet Birand). *Ziraat Vekaleti Yay.* 60: 1-29.
- Louis, H. (1939). *Das natürliche Pflanzenkleid Anatoliens.* Geograpisch gesehen. Stuttgart.
- Quézel, P. (1964). Vegetation des hautes montagnes de la Grece méridionale. *Vegetatio* 12, (5-6).
- Quézel, P. (1973). Contribution a l' etude phytosociologique du massif du Taurus. *Phytocoenologia* 1 (2), 131-222.
- Quézel, P., Barbero, M. & Akman, Y. (1992). Typification de syntaxa décrits en region méditerranéenne orientale. *Ecologia Mediterranea* XVIII, 81-87.
- Tatli, A. (1991). Phytosociological investigation of vegetation of wind-eroded areas of Eastern Anatolia. *Ecologia Mediterranea* XVII, 161-168.
- Walter, H. (1962). *Anadolu vejetasyonunun yapisi.* (Çeviri: Selman Uslu). I. U. Orm. Fak. Yay. No.: 60.
- Weber, H.E., Moravec, J. & Theurillat, J.P. (2000). International code of phytosociological nomenclature. 3rd edition. *Vegetation Science* 11, 739-768.
- Yaltirik, F., Akman, Y. & Ketenoglu, O. (1983). A phytosociological research in the Belgrad forest. *Comm. Fac. Sci. Univ. Ankara* 27 (C), 1-9.
- Zohary, M. (1973). *Geobotanical foundation of the Middle East.* Vol. 1-2. Stuttgart, Amsterdam.
- Osman KETENOĞLU**, 1950 yılında Kastamonu'da doğdu. Ankara Üniversitesi Fen Fakültesi Botanik bölümünden 1973'de mezun oldu. Halen Ankara Üniversitesi Fen Fakültesi Biyoloji Bölümü Ekoloji ve Çevre Biyolojisi A.B.D
- başkanlığını yürütmektedir. Evli ve 2 çocuk babasıdır.
- Mustafa AYDOĞDU**, 1952 yılında Ankara'da doğdu. Atatürk Üniversitesi Biyoloji Bölümünden 1977 yılında mezun oldu. Halen Gazi Üniversitesi Gazi Eğitim Fakültesi İlköğretim Bölümü Fen Bilgisi Eğitimi A.B.D'da çalışmalarına devam etmektedir. Evli ve 2 çocuk babasıdır.
- Latif KURT**, 1966 yılında Ankara-Kalecik'de doğdu. Ankara Üniversitesi Fen Fakültesi Biyoloji bölümünden 1988'de mezun oldu. Halen Ankara Üniversitesi Fen Fakültesi Biyoloji Bölümü Ekoloji ve Çevre Biyolojisi A.B.D'da görev yapmaktadır. Evli ve 1 çocuk babasıdır.
- Ergin HAMZAOĞLU**, 1967 yılında Kars-Susuz'da doğdu. Gazi Üniversitesi Gazi Eğitim Fakültesi Biyoloji Eğitimi A.B.D.'dan 1990 yılında mezun oldu. Halen Yozgat Bozok Üniversitesi Biyoloji Bölümünde çalışmalarına devam etmektedir. Evli ve 4 çocuk babasıdır.
- Gül Nilhan TUĞ**, 1974 yılında Trabzon'da doğdu. Orta Doğu Teknik Üniversitesi Fen Edebiyat Fakültesi'nden 1998 yılında mezun oldu. Halen Ankara Üniversitesi Fen Fakültesi Biyoloji Bölümü Ekoloji ve Çevre Biyolojisi A.B.D'da görev yapmaktadır.
- Neslihan ARSLANTÜRK**, 1977 yılında Ankara'da doğdu. Ankara Üniversitesi Fen Fakültesi Biyoloji bölümünden 1997'de mezun oldu. Halen Mehmet Akif Üniversitesi Biyoloji Bölümü Botanik A.B.D.'nda çalışmalarına devam etmektedir. Evlidir.

