



Gypsum Areas and Endemism in SİVAS



PROF.DR. H. AŞKIN AKPULAT

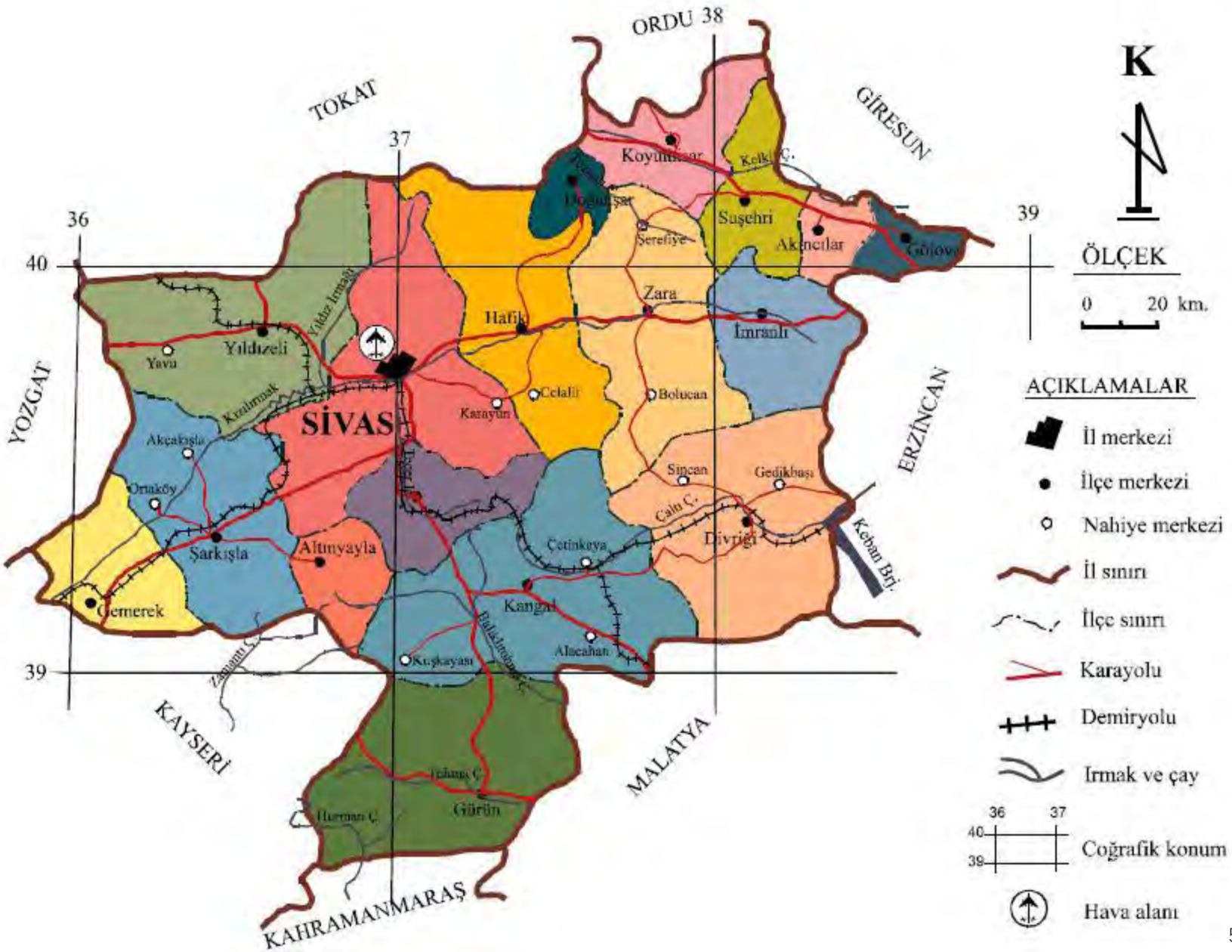
Cumhuriyet University Sivas/TURKEY



Gypsum ($\text{CaSO}_4 \cdot 2\text{H}_2\text{O}$)







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- ▣ Floristic studies considering soil structure, particularly pure **floristic** studies in gypsum, are very rare. The restriction of vascular plant species in soil which is high in gypsum was **first** reported by Johnston (1941) from the Chihuahuan Desert of northern Mexico, and has since been observed in many arid and semi-arid regions of the world (Parsons, 1976).

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- However, the features of the gypsum habitat which provide the selective force for the evolution of gypsophile endemics have not been clearly **identified** (Powell and Turner, 1977).

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- Gypsum outcrops have a scattered distribution in arid and semi-arid areas throughout the world, covering about 100 million ha (Boyadgiev & Verheye 1996).
 - Due to their particular chemical and physical properties, they harbour a unique flora, with a high degree of rare and endemic taxa (Parsons 1976; Meyer 1986; Akpulat & Celik 2005; Moore & Jansen 2007).

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- Consequently, this habitat type is included in the European Habitat Directive (Anonymous [2003](#)) as a priority for conservation.
 - In turn, many of the characteristic plant species are under different degrees of threat and thus are included in red lists and red books and are protected by international, national or regional legislation (e.g. Anonymous [2003](#))

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- Gypsum areas occupy **0.5%** of Turkey (Boyadgiev, 1976; Jafarzadeh and Zink, 2000) and the largest fraction of gypsum occurs within Sivas province (Alagöz, 1967; Gökçe and Ceyhan, 1988).
 - Gypsum ($\text{CaSO}_4 \cdot 2\text{H}_2\text{O}$) is widely distributed in **Sivas(Turkey)**, occurring **chiefly** in the formations of Miocene age.

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- It forms a particular site due to the soil characteristics derived from the gypsiferous mother rocks.
 - **“Gypsiferous soils”** refers to soil with more than ($\geq 2\%$ gypsum) (Ketenoglu et al., 2000).

	Country	km²	% of total area of country	% of area of gypsiferous soils
Africa	Morocco	1114.3	2.5	1.7
	Algeria	7966.3	3.3	12.2
	Tunisia	1439.8	9.3	2.2
	Libya	3956.8	2.2	6.0
	Egypt	382.2	0.4	0.6
	Sudan	785.0	0.3	1.2
	Somalia	10161.2	16.2	15.5
	Ethiopia	1423.4	1.3	2.2
	Mali	2818.3	2.3	4.3
	Mauritania	396.0	0.4	0.6
	Namibia	5327.7	6.5	8.2

	Country	km ²	% of total area of country	% of area of gypsiferous soils
Southern Asia	Syria	3966.6	21.6	6.0
	Jordan	80.5	0.8	0.1
	Saudi Arabia	82.5	0.04	0.1
	Oman	471.6	-	0.7
	Yemen A.R.	2931.0	8.8	4.5
	Kuwait	354.6	-	0.5
	Iraq	4779.2	11.0	7.3
	Iran	4.2	-	-
	Pakistan	9.5	0.01	-
	India	182.0	0.06	0.3
Central Asia	USSR	5074.1	0.2	7.7
	Mongolia	60.9	0.04	0.1
	China	11484.9	1.2	17.5
Europe	Turkey	64.2	0.08	0.1
	Spain	165.5	0.3	0.3
North America	New Mexico	78.0	-	0.1

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- Massive gypsum covers a large area around **Sivas, Zara and İmranlı** which is extensively karstified with numerous sink holes and depression.
 - **Hafik** Lake to the east of Sivas, **Tödürge** Lake to the west of Zara and **Ulaş-** Lake to the south of Sivas now occupy the karst depression (Nebert, 1956; Ceyhan, 1987)

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- Plant specimens are collected from the areas where gypsum is dense and clearly seen at the surface.
 - Therefore these areas can be **defined** as gypsum habitats without any doubt.

Gypsum and poliploidy

- ❑ Polyploidy is widespread in plants and has been a major feature in plant evolution.
- ❑ Somatic chromosome numbers were found to be $2n=2x=18$ in *Achillea sipikorensis* and $2n=4x=36$ in *Achillea sintenisii* for the first time (Akpulat & Turkoglu, 2005).

Gypsum and poliploidy

Achillea sipikorensis



Achillea sintenisii



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- The materials of this study are 1450 vascular plant specimens collected from Sivas between 2001 and 2003.
 - They were dried by means of standard herbarium methods.

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- During this study 1450 vascular plant specimens were collected from the area and 328 species (340 taxa) belonging to 164 genera **classified** within 45 families were established.
 - One species belongs to Gymnospermae while the other 339 were Angiospermae. Dicotyledones and Monocotyledones consist of 296 and 43 taxa, respectively.
 - A summary of the numerical data is presented in Table 2.

Table 2: Floristik properties of the research area

	Gymno.	Dicots.	Monocots.	Total
Families	1	40	4	45
Genera	1	142	21	164
Species	1	286	41	328
Subspecies		8		8
Varieties		3	1	4
Emdemic taxa		108	14	122
Medit		6	3	9
E. Medit.		4	1	5
Ir-Tur.		149	24	173
Euro.-Sib.		4	2	6
Hyrc.-Euxine		1		1
Euxine		2		2
Others				
EX				
EW				
CR		6		6
EN		8		8
VU		13	1	14
NT		14		14
LC		64	13	77
DD		3		3
NE				

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- A total of 122 taxa are found to be endemic for Turkey and the ratio of endemism is 35.8%.
 - The proportion of endemism in the area is higher than the average estimated for Turkey (34.4%) (Ozhatay et al., 2003).
 - The reason for this is assumed to be gypsum habitats.

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- The chief advantage on gypsum for the gypsophile species may be reduced moisture stress during the early summer drought, due either to reduced competition for water because of low densities or to intrinsic properties of the gypsum soil (Meyer, 1986).

Totals of the largest families in the study area

<u>Familia</u>	<u>Genera</u>	<u>Taxon</u>	<u>(%) Taxon</u>
1. Asteraceae	22	61	17.7
2. Fabaceae	13	39	11.5
3. Lamiaceae	14	38	11.3
4. Liliaceae	10	25	7.3
5. Brassicaceae	13	24	7.1
6. Caryophyllaceae	6	21	6.3
7. Apiaceae	14	16	4.7
8. Boraginaceae	7	16	4.7
9. Poaceae	7	10	3.0
10. Scrophulariaceae	7	10	3.0
Other families	51	80	23.4
Total	164	340	100

Taxon totals of the largest genera in the study area

Genus	Number of taxon	(%) Taxon
Astragalus	17	5.0
Salvia	13	3.7
Centaurea	13	3.7
Achillea	8	2.4
Silene	7	2.0
Gypsophila	7	2.0
Onobrychis	6	1.8
Onosma	6	1.8
Allium	6	1.8
Helichrysum	5	1.5
Iris	5	1.5
Others genus	247	72.8
Total	340	100

Gypsum habitat

- However, eight of these taxa grow only in gypsum. These taxa are
- *Scrophularia gypsicola* Hub.-Mor. & Lall,
- *Thymus spathulifolius* Hausskn. & Velen,
- *Gypsophila heteropoda* **subsp. minutiflora**,
- *Reaumuria sivasica* **Kit Tan & Yıldız**,
- *Campanula sivasica* **Kit Tan & Yıldız**,
- *Allium sivasicum* Özhatay & Kollmann and
- *Centaurea yildizii*.
- *Achillea gypsicola*

Yapılan Çalışmanın Adı	Endemizm Oranı (%)
Sivas ili Jipsli Alanlarının Florası	35.8
Tödürge Gölü (Sivas)	25.3
Hafik ve Çevresi Jipsli Toprakların Florası (Sivas)	25.3
Tecer Dağları Florası (Sivas)	22.5
Hınzır Dağı Florası (Kayseri)	21.2
Taşlıdere Florası (Sivas)	18.6
Sivas-Sıcak Çermik Arası Florası (Sivas)	17.8
Sivas-Hafik Arası Florası (Sivas)	17.7
Gövdeli Dağı Florası (Kayseri-Sivas)	17,7
Berit Dağı Florası (Kahramanmaraş)	16.0
İncebel Dağları Florası (Kayseri-Sivas)	15.0
Köse Dağı Florası (Sivas)	14.5
Deveci Dağları Florası (Yozgat-Tokat)	14.2
Çamlıbel-Yıldız Dağları Florası (Sivas-Tokat)	14.1
Kızılınış-Geyraz Arası Florası (Tokat)	10.4

As a result,

- this study is conducted in a region of Turkey where the most abundant gypsum areas are present. A list of taxa occurring in gypsum is presented according to the data generated.
- Some taxa with unknown habitat information are recorded as gypsum elements.

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- ❑ Liliaceae ranking as fourth largest family in the study area shows that monocotils have very special relation with gypsum.
 - ❑ High endemism ratio (35.8%) implicate that more detailed studies are needed in gypsum areas.

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- The other 25 taxa can be found in various habitats other than gypsum.
 - These are mainly calcareous and salty habitats

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- ❑ The taxa which habitat characteristics were not given in the Flora and collected in gypsum areas during this study are
 - ❑ *Chrysocamela elliptica* (Boiss.) Boiss.,
 - ❑ *Minuartia anatolica* (Boiss.) Woron var. *tetrasticha* McNeill,
 - ❑ *Erodium cicutarium* (L.) L' Herit **subsp. cicutarium**,
 - ❑ *Astragalus glaucophyllus* Bunge,
 - ❑ *Onobrychis stenostachya* Freyn subsp. *krauserii* (Sirj.) Hedge,
 - ❑ *Sanguisorba minor* Scop. subsp. *minor*,
 - ❑ *Allium scorodoprasum* L. subsp. *rotundum* (L.) Stearn and
 - ❑ *Hieracium cappadocicum*.

Conclusion

- High endemism
- Poliploidi
- Different habitat
- Biodiversity

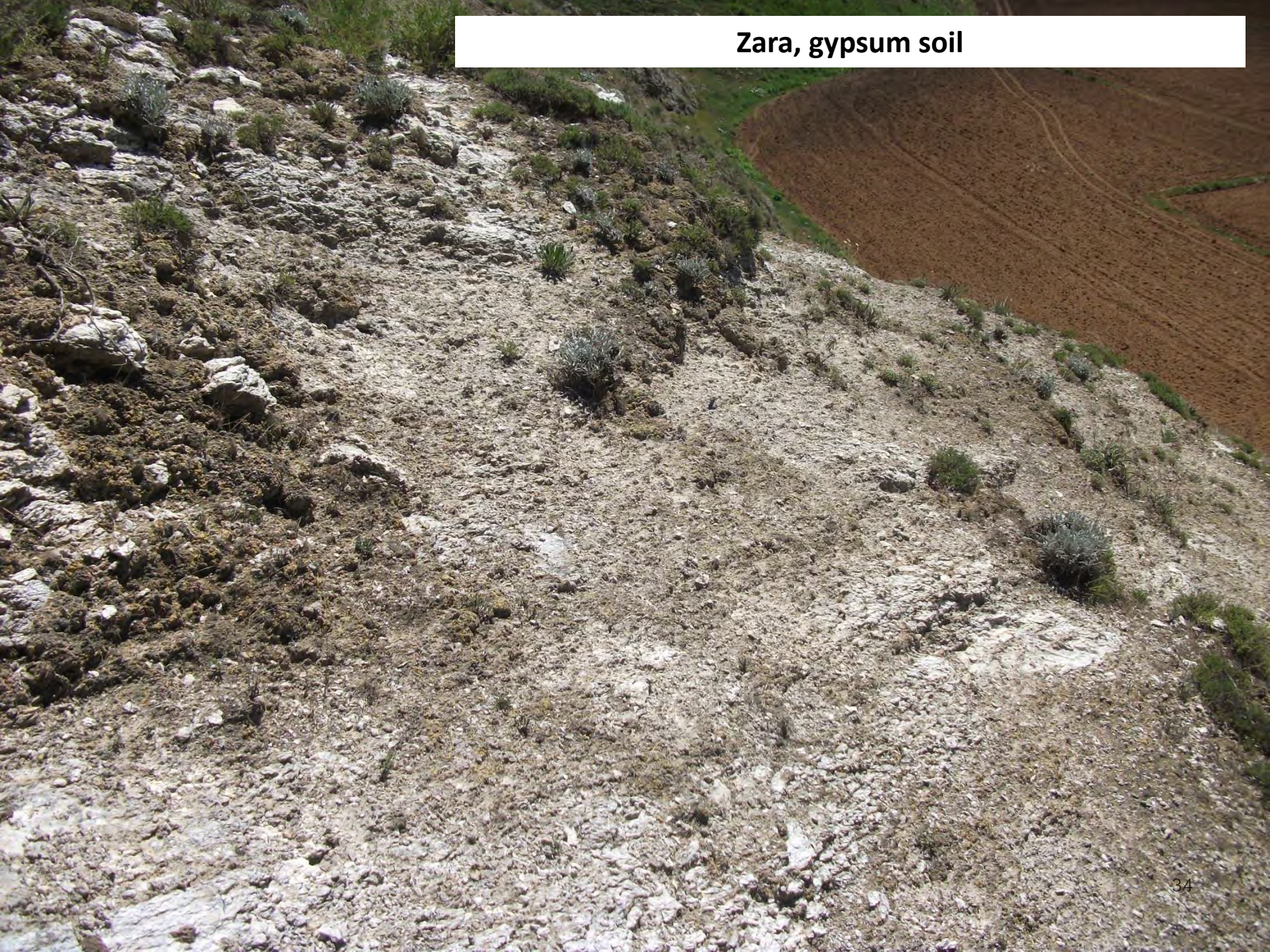
Tecer gypsum



Ulaş-Ziyarettepe, gypsum soil



Zara, gypsum soil



İmranlı gypsum soil



İmranlı gypsum soil



Karayün-Celalli



Zara-İmranlı gypsum soil



İmranlı gypsum



Tödürge Lake (Sivas-TURKEY)



Endemic plants that grow in gypsum soil.



Onosma sintenisi END. VU

Endemic plants that grow in gypsum soil.



Muscari anatolicum END. NT

Endemic plants that grow in gypsum soil.



Hyacinthella acutiloba END. LC

Endemic plants that grow in gypsum soil.



Allium sivasicum END. LC

Endemic plants that grow in gypsum soil.



Chrysocamela noeana END. EN



Endemic plants that grow in gypsum soil.



Glaucium acutidentatum END. LC

Endemic plants that grow in gypsum soil.



Gypsophila eriocalyx END. LC

Endemic plants that grow in gypsum soil.



Scrophularia lepidota END. VU



Endemic plants that grow in gypsum soil.



Centaurea sivasica END. NT



Endemic plants that grow in gypsum soil.



Gypsophila heteropoda subsp. *minutiflora* END. DD

Endemic plants that grow in gypsum soil.



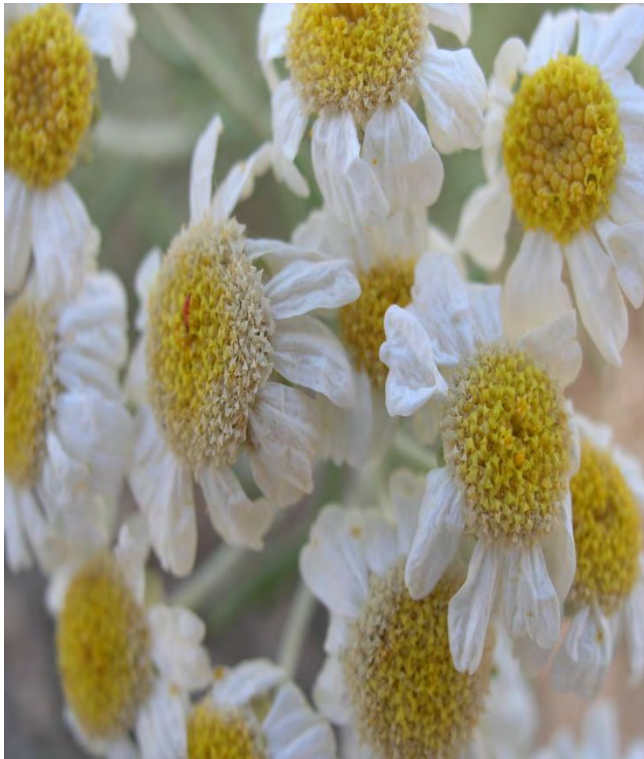
Helichrysum noeanum END. LC

Endemic plants that grow in gypsum soil.



Matthiola anchonifolia END. NT

Endemic plants that grow in gypsum soil.



Achillea sintenisi END. NT

Endemic plants that grow in gypsum soil.



Achillea sipikorensis END. NT

Endemic plants that grow in gypsum soil.



Achillea gypsicola END. VU

Endemic plants that grow in gypsum soil.



Ajuga chamaepitys (L.) SCHREBER *subsp. chia*

Endemic plants that grow in gypsum soil.



Nonea stenosolen END. LC

Endemic plants that grow in gypsum soil.



Ebenus laguroides var. *laguroides* END



Endemic plants that grow in gypsum soil.



Scorzonera tomentosa END LC

Endemic plants that grow in gypsum soil.



Hedysarum pestalozzae END. LC

Endemic plants that grow in gypsum soil.



Thymus pectinatus var. *pectinatus* END. NT

Endemic plants that grow in gypsum soil.



Isatis glauca subsp. *iconia* END. LC

Endemic plants that grow in gypsum soil.



Salvia cryptantha END. LC

Endemic plants that grow in gypsum soil.



Astragalus christanus END. LC

Endemic plants that grow in gypsum soil.



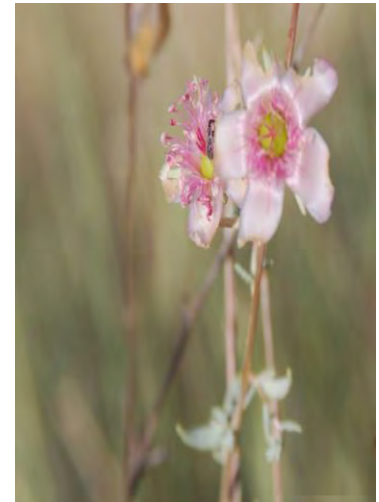
Iris sari **END LC**

Endemic plants that grow in gypsum soil.



Thymus spathulifolius Hausskn. et Velen. END. CR

Endemic plants that grow in gypsum soil.



Reaumuria sivasica (CR)





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Flora of gypsum areas in Sivas in the eastern part of Cappadocia in Central Anatolia, Turkey

H.A. Akpulat  , N. Celik

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Abstract

This research was carried out in Sivas province between 2001 and 2003 years and 1450 plant specimens were collected during this period. Identification of the



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