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Determination of the quality degree, grazing capacity and hay quality of rangelands in different directions and altitudes

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Abstract
This study was conducted to determine the rangeland quality degree, grazing capacity and hay quality of rangelands at four different directions and three altitudes. The best rangeland quality degree was determined in rangelands facing the North (3.41) and at 1704 m altitude (3.84), and rangelands condition was classified as "poor". Grazing capacity of the rangelands was determined to be 41.01 animal unit, and required rangelands area for 1 animal unit was calculated to be 2.44 hectares. The dry hay content was determined to be 18.50% crude protein, 36.4% acid detergent fiber, 52.1% neutral detergent fiber, 60.5% digestible dry matter, 2.39% dry matter intake, 113.5 relative feed value, 0.30% phosphor, 2.00% potassium, 1.63% calcium, and 0.38% magnesium. West and South directions in terms of crude protein; South direction and 1704 m altitude in terms of phosphor; South, East and West directions in terms of calcium; West direction, 1704 m and 1876 m altitudes in terms of magnesium gave the best results.
Key words: Altitude, Direction, Quality, Pasture, Bingöl

Introduction

The first people gathered their herbal nutrient needs from the natural life and obtained their animal nutrient needs from by hunting. In later periods, the human who domesticated some animals, faced with the problem of feeding animals. This situation has led to natural meadow and rangeland being the main source of animal feeding (Aydın and Uzun 2002).

Forage crops and the plant of meadow-rangeland areas are two main sources of animal feed. Meadow and rangeland areas, which are the cheapest source of feed, are the areas that provide the most feed to our country's livestock. According to the Turkey Statistical Institute data, our country has a total area of 14.6 million hectares of rangeland. This amount corresponds to 37.2% of the total agricultural land (Ekiz et al. 2011).

The rangeland areas although they have a significant potential in terms of agriculture and livestock in our country they are weak due to bad use. In order to contribute to country animal husbandry, we need to improve and sustainable our rangeland areas. It is possible to realize this by revealing many features of our rangelands. Some of these features are the identification of the plant species, the calculation of grazing capacity and rangeland quality degree and determine the hay quality of rangelands. In order to determine hay quality, some data such as crude protein, ADF (acid detergent fiber), NDF (neutral detergent fiber) and macro elements (Ca, Mg, P and K) should be obtained as a result of the analysis.

The crude protein, ADF, NDF, Ca, Mg, P and K values are the parameters that determine the quality of the hay produced in our rangelands. ADF and NDF values represent compounds comprising the plant cell wall and these ratios are required to be low for the quality of hay that is consumed as forage. When the ADF and NDF ratios are low, the DDM (digestible dry matter), DMI (dry matter intake) and RFV (relative feed value) rates are high. Ca, Mg, P and K values are also very important in animal nutrition. The rates in forages directly affect the quality.

In similar studies; crude protein ratio ranged from 5.1% to 18.81% (Yilmaz 1977, Tukel et al. 1999, Koc et al. 2000, Cinar 2001, Bakoglu and Koc 2002, Turker 2006, Comakli et al. 2008, Erkovan et al. 2009, Gullap 2010, Nadir 2010, Sahinoglu 2010, Sen 2010, Budakli and Carpici 2011), ADF from 24.1% to 51.3% and NDF from 34.5% to 74.3% (Erkovan et al. 2009, Balabanli et al. 2010, Gullap 2010, Nadir 2010, Sahinoglu 2010, Budakli and Carpici 2011), RFV from 113.3 to 189.7 (Nadir 2010, Sahinoglu 2010), Ca ranged from 0.62% to 1.33%, Mg ranged from 2147.6 to 2825 ppm and 0.26% to 0.36, P ranged from 533.1 to 1392 ppm and 0.40% to 0.43%, K ranged from 1.36% to 2.69% (Koc et al. 2000, Bakoglu and Koc 2002, Comakli et al. 2008, Sahinoglu, 2010).

The rangeland quality degree ranged from 2.24 to 6.00 (Ozmen 1977, Alan and Ekiz 2001, Bakoglu and Koc 2002, Babalik 2008, Sen 2010), The rangeland area needed for 1 AU (animal unit) ranged from 0.4 ha to 3.05 ha (Cinar 2001, Uslu 2005, Turker 2006, Babalik 2008, Agin 2012) and grazing capacity ranged from 1.62 to 2.68 AU (Cinar 2001, Uslu 2005, Turker 2006, Babalik 2008, Agin 2012).

The aim of this study is to compare the hay quality of the rangelands in terms of altitudes and direction and to reveal the grazing capacity and quality degree of these rangelands.

Material and Methods

This research was conducted in the common rangeland of Yelesen and Dikme villages in the city center of Bingol Province from Turkey, within the first week of June and during blooming in 2012 and 2013. Some climate data of Bingol were provided from Directorate of Meteorology. According the meteorological data of research area, the long-term (1960-2012) monthly average temperature is 12.01 ºC, total precipitation is 942.3 mm and relative humidity is 57.2%. In the period of the study (2012-2013), the temperature and the relative humidity were measured close to the long-term average (12.7 ºC in 2012, 13.3 ºC in 2013 for temperature and 53.9% in 2012, 50.1% in 2013 for relative humidity). However, the precipitation in Bingol in 2012 was higher, and the precipitation in 2013 was lower than the long-term average.

The soil samples, which totals 12 for each year, were collected from different points at four directions and three altitudes in the research area from 0-30 cm depth. The soil samples were analyzed in the Soil-Plant Analysis Laboratory of Bingol University Agriculture Faculty. The analysis results were evaluated based on limit values set by Karaman (2012). According to the analysis results, it was determined that at each direction and altitude soils of the research area clay-loamy, EC rate unsalty (0.06%), pH contents slightly acidic (6.89), medium in calcium carbonat (7.27%) and organic matter (2.57%), enough in nitrogen (1.30 g/kg), low in phosphor (50.0 kg/ha) and enough in potassium (460.7 kg/ha) (Table 1).

The vegetation measurement of the research area was conducted in the not grazed parts using “point frame” method. Based on the direction the side of the mountains face, different study areas were determined as North, South, East and West direction. Three different rangeland altitudes (average altitudes; 1992 m, 1876 m, 1704 m) were determined for each direction. Thus, twelve rangeland parts representing the area of research were determined. In the study, one direction was calculated by taking the average of three altitudes. Likewise, one altitude it consists of the average of four different directions at the same altitude. For the entire study observations were made at 4800 points, 400 points for each part of rangeland.

Table 1. Soil analysis of the research area.

	Structure	EC(%)	pH	$CaCO_3$(%)	OM(%)	N (g/kg)	P(kg/ha)	K(kg/ha)
North	Loamy	0.050	6.75	7.62	2.78	1.40	53.3	399.5
South	Clay-Loamy	0.048	6.93	8.55	3.17	1.60	50.5	490.0
East	Clay-Loamy	0.087	7.04	6.92	2.30	1.20	48.3	474.2
West	Clay-Loamy	0.054	6.84	5.98	2.04	1.00	47.9	479.0
Average		**0.060**	**6.89**	**7.27**	**2.57**	**1.30**	**50.0**	**460.7**

	Structure	EC(%)	pH	CaCO3(%)	OM(%)	N (g/kg)	P(kg/ha)	K(kg/ha)
1992 m	Clay-Loamy	0.035	6.66	5.23	2.55	1.31	52.1	461.5
1876 m	Clay-Loamy	0.073	6.96	8.27	2.70	1.33	49.2	453.1
1704 m	Clay-Loamy	0.071	7.06	8.31	2.47	1.28	48.7	467.4
Average		**0.060**	**6.89**	**7.27**	**2.57**	**1.30**	**50.0**	**460.7**

Rangeland quality degree was calculated for each rangeland part by multiplying the botanical composition rate of the plant species observed at each rangeland by significance number of each plant species using the method given by Gokkus et al. (2000). Rangeland condition was determined according to rangeland condition scale (0.0-2=Too poor, 2.1-4=Poor, 4.1-6=Medium, 6.1-8=Good, 8.1-10=Too good) provided by the same author.

Grazing capacity was calculated according to the following equation which is widely used in our country (Erkun 1971, Yilmaz 1977, Tukel 1981).

$$Grazing\ capacity = \frac{\text{Rangeland area (ha)} \times \text{Rangeland yield} \left(\frac{kg}{ha}\right) \times \text{Utilizable forage rate}}{\text{Forage consumption one of an animal per day (kg)} \times \text{number of grazing days}}$$

The rangeland area needed at a grazing season for an animal unit (AU) was calculated according to the following equation (Bakir 1970).

$$Necessary\ rangeland\ area\ for\ an\ animal\ unit\ (ha) = \frac{\text{Number of grazing days (day)} \times \text{hay needed for a cattle unit per day (kg)}}{\text{Rangeland yield} \left(\frac{kg}{ha}\right) \times Utilizable\ forage\ rate\ (\%)}$$

The green and hay yield were obtained by placing a frame (33x33 cm) at 25 m displacement along each line drawn at each direction and altitude, and cutting herbage and shrub within the frames at a total of 48 regions. Dried herbs were milled with hand mill machine and the samples obtained were sent to the Chemical Analysis Laboratory of Ondokuz Mayıs University Agriculture Faculty. The quantity of crude protein (CP), acid detergent fiber (ADF), neutral detergent fiber (NDF), phosphor (P), potassium (K), calsium (Ca) and magnesium (Mg) were analyzed by NIRS (Near Infrared Spectroscopy - Foss Model 6500). Digestible dry matter (DDM =88.9 - (0.779 x %ADF), dry matter intake (DMI=120 / %NDF) and relative feed value (RFV=DDM x DMI) / 1.29) were calculated with aid of ADF and NDF determined (Morrison 2003).

The variance analysis suitable for a randomized block design with four replications for the findings obtained in the study were carried out by JMP statistical package program. The averages of the factors which were found to be statistically important by the variance analysis findings were compared with LSD test.

Results

Rangeland Condition According to Quality Degree

The rangeland quality degrees obtained by using botanical composition values are given in appendix 1. The rangeland quality degrees in different directions and altitudes and rangeland condition corresponding to these degrees are given Table 2. Average rangeland quality degree was determined to be 3.00 with the best at the North direction as 3.41 and with the lowest rangeland degree obtained at the South direction as 2.63. The rangeland status of all directions was determined as "poor".

Table 2. The rates and averages rangeland quality degree and rangeland condition determined at different directions and altitudes.

	Rangeland Quality Degree	Rangeland Condition
North	3.41	Poor
South	2.63	Poor
East	2.84	Poor
West	3.13	Poor
Average	**3.00**	**Poor**
1992 m	1.86	Too Poor
1876 m	3.18	Poor
1704 m	3.84	Poor
Average	**2.96**	**Poor**

Average rangeland quality degree was found as 2.96 with the best rangeland quality degree at an altitude of 1704 m (with 3.41), and the lowest rangeland degree at an altitude of 1992 m (with 2.63). Rangeland status were determined as "poor" at 1704 m and 1876 m altitudes and "too poor" at the altitude of 1992 m.

Although the rangeland status at all directions and altitudes was determined as "poor", rangeland quality decreases as altitude increases and rangeland quality of the North direction gave better findings.

Grazing Capacity

Grazing capacity is emerges as 41.01 AU in a 140 days in grazing period (20 May–10 October), 100 ha rangeland area with 1435.4 kg/ha average hay yield, 12.5 kg of dry matter that can be consumed daily by a 500 kg animal with benefit ratio of 0.50 (Tukel and Hatipoglu 1997).

$$\text{Grazing capacity} = \frac{100\ \text{ha} \times 1435.4\ \frac{kg}{ha} \times 0.5}{12.5\ kg\ \frac{1}{day} \times 140\ day} = 41.01\ \text{AU}$$

Rangeland area has the capacity to respond to the needs of 41 AU. Considering grazing periods and the amount of hay an animal consumes daily, the rangeland area needed per animal in a grazing season is calculated as 2.44 ha.

$$\text{Necessary rangeland area for one AU} = \frac{140 \times 12.5}{1435.4 \times 0.50} = 2.44\ \text{ha}$$

The rates of CP, ADF and NDF

The rates and averages of CP, ADF, NDF determined at different directions and altitudes are given Table 3. In terms of directions, CP rates showed statistical differences. The highest CP rate was calculated as 19.8% and 18.7% for West and South directions respectively, the lowest CP rate was obtained at the North direction with 17.1% and at the East direction with 18.3%. The In terms of CP, ADF and NDF the second year had a higher ratio than the first year. In two year averages, the ratio of CP in terms of only altitudes and the ratio of ADF and NDF in terms of directions don't show statistical differences. Considering generally the averages of directions and altitudes, the average ratio of CP, ADF, and NDF are observed to be 18.5%, 36.4%, and 52.1% respectively.

Table 3. The Rates and Averages of CP, ADF, NDF Determined at Different Directions and Altitudes.

	Crude Protein (%)			ADF (%)			NDF (%)		
	2012	**2013**	**AVG**	**2012**	**2013**	**AVG**	**2012**	**2013**	**AVG**
North	15.3 B*	18.9 B*	17.1 C**	32.7	41.7	37.2	47.3	62.6 A**	54.9
South	15.6 B	21.7 A	18.7 AB	32.6	37.9	35.3	47.0	53.2 B	50.1
East	15.4 B	21.2 A	18.3 BC	35.0	38.8	36.9	47.4	54.2 B	50.8
West	17.8 A	21.8 A	19.8 A	31.7	40.5	36.1	42.5	62.3 A	52.4
1992 m	16.9 A**	20.3	18.6	32.5 B**	41.3 A*	36.9	46.2	61.9 A**	54.1
1876 m	14.4 B	21.8	18.1	36.9 A	37.2 B	37.0	48.3	55.4 B	51.9
1704 m	16.7 A	20.6	18.7	29.6 B	40.7 A	35.1	43.7	56.9 B	50.3
AVG	**16.0 b**	**20.9 a****	**18.5**	**33.0 b**	**39.7 a****	**36.4**	**46.1 b**	**58.1 a****	**52.1**

*) The significant at 5% probability,**) The significant at 1% probability, AVG=Average

The Rates of DDM, DMI and RFV

General ratios and averages related to DDM, DMI and RFV calculated from the ratio of ADF and NDF that were detected at different directions and altitudes are given Table 4. Considering the two year averages given in the Table 4, it is seen that there is no statistically significant difference; however, DDM, DMI and RFV shows a statistical difference through the years. The ratio of DDM DMI and RFV were observed to be 60.5%, 2.39% and 113.5 respectively considering generally the averages of directions and altitudes.

Table 4. The Rates and Averages of DDM, DMI, RFV Determined at Different Directions and Altitudes

	DDM (%)			DMI (%)			RFV		
	2012	**2013**	**AVG**	**2012**	**2013**	**AVG**	**2012**	**2013**	**AVG**
North	63.4	56.4	59.9	2.57	1.92 B**	2.25	126.9	84.3 B**	105.6
South	63.5	59.3	61.4	2.59	2.31 A	2.45	128.5	107.1 A	117.8
East	61.6	58.6	60.1	2.65	2.25 A	2.45	129.4	102.6 A	116.0
West	64.2	57.3	60.7	2.85	1.95 B	2.40	142.3	87.0 B	114.7
1992 m	63.5 A**	56.7 B**	60.1	2.62	1.96 B**	2.29	129.5	86.3 B*	107.9
1876 m	60.2 B	59.9 A	60.0	2.59	2.18 A	2.39	122.9	101.4 A	112.1
1704 m	65.8 A	57.2 B	61.5	2.79	2.19 A	2.49	142.9	98.11 A	120.5
AVG	**63.2 a****	**57.9 b**	**60.5**	**2.67 a****	**2.11 b**	**2.39**	**131.8a****	**95.3 b**	**113.5**

*) The significant at 5% probability,**) The significant at 1% probability , AVG=Average

The rates of Phosphor (P), Potassium (K), Calcium (Ca) and Magnesium (Mg)

The rates and averages for P, K, Ca and Mg determined at different directions and altitudes are given in Table 5. As seen in Table 5, the ratio of P and Mg in terms of directions and altitudes and Ca only in terms of directions showed statistically significant differences. However, the ratio of K in terms of directions and altitudes do not show any statistical difference.

In terms of directions, the highest P rate with 0.34% in South direction, the highest Ca rates with 1.71% in East, 1.69% in West and 1.68% in South directions, the highest Mg rate with 0.43% in West direction were obtained. In terms of altitudes, the highest P rate with 0.32% at 1704 m altitude, the highest Mg rate with 0.40% at 1704 m and 1876 m altitudes were obtained. The ratio of P, K, Ca and Mg were observed to be 0.30%, 2.00%, 1.63% and 0.38% respectively considering generally the averages of directions and altitudes.

Table 5. The rates and averages of P, K, Ca, Mg determined at different directions and altitudes.

	P (%)			K (%)			Ca (%)			Mg (%)		
	2012	**2013**	**AVG**	**2012**	**2013**	**AVG**	**2012**	**2013**	**AVG**	**2012**	**2013**	**AV**
North	0.30 A*	0.28 B**	0.29 B**	2.02 A*	2.19	2.11	1.24 B**	1.69	1.46 B*	0.36	0.35 B*	0.36 B**
South	0.29 A	0.39 A	0.34 A	1.75 AB	2.25	2.00	1.45 A	1.90	1.68 A	0.33	0.41 AB	0.37 B
East	0.25 B	0.34 A	0.30 B	1.29 B	2.35	1.82	1.64 A	1.78	1.71 A	0.36	0.37 B	0.37 B
West	0.29 A	0.25 B	0.27 B	1.95 A	2.22	2.09	1.46 A	1.92	1.69 A	0.42	0.45 A	0.43 A
1992 m	0.29 A**	0.28 B**	0.28 B*	1.91	1.99	1.95	1.48	1.89	1.69	0.36	0.34 B**	0.35 B*
1876 m	0.25 B	0.34 A	0.30 B	1.62	2.41	2.01	1.42	1.83	1.62	0.38	0.42 A	0.40 A
1704 m	0.31 A	0.33 A	0.32 A	1.73	2.36	2.05	1.44	1.75	1.60	0.37	0.42 A	0.40 A
AVG	**0.28 b**	**0.32 a****	**0.30**	**1.75 b**	**2.25 a****	**2.00**	**1.45 b**	**1.82 a****	**1.63**	**0.37**	**0.39**	**0.38**

*) The significant at 5% probability,**) The significant at 1% probability, AVG=Average

DISCUSSION

It is observed that as altitude increases the vegetation and rangeland quality decrease. The real reason why rangeland condition was found as "poor" at all directions and altitudes is no doubt the uncontrolled grazing continued for long years. The results we obtained are confirmed with those obtained by Ozmen (1977) Alan and Ekiz (2001), Bakoglu and Koc (2002), Babalik (2008) and Sen (2010).

Rangeland area has the capacity to respond to the needs of 41 AU and rangeland area needed per animal in a grazing season is calculated 2.44 ha. In similar studies, the pasture area required per animal was determined as 1.97 ha by Bakoglu (2004), 2.03 ha by Uslu (2005) and 3.05 ha by Turker (2006). The findings we obtained conforms with the results in the literature.

No statistically significant difference was found between the ADF and NDF ratios. Because the North and the West directions only have less sunshine, the maturation of these plants is delayed. Therefore, the ratio of crude protein in plants in this region is higher. Crude protein findings are similar to the findings obtained by Koc et al. (2000), Nadir (2010), Sahinoglu (2010) and Sen (2010).

When the averages of the directions and altitudes are examined; the rate of ADF was found to be 36.4%, the rate of NDF was 52.1%, the rate of DDM was 60.5%, DMI rate was 2.39% and RFV was 113.5. It is desired that the ADF and NDF ratios are low in terms of the quality of dry grass consumed as feed. When the ADF and NDF ratios were low, the rates of DDM, DMI and RFV were higher. The findings we obtained about ADF, NDF and RFV are parallel to the results literature (Erkovan et al. 2009, Balabanli et al. 2010, Gullap 2010, Nadir 2010, Sahinoglu 2010, Budakli and Carpici 2011).

When the averages of the directions and altitudes are examined; the rate of P was found to be 0.30%, the rate of K was 2.00%, the rate of Ca was 1.63% and Mg rate was 0.38%. The findings obtained about K are parallel to the literature findings, P findings are lower, Ca and Mg findings are higher than literature findings (Koc et al. 2000; Bakoglu and Koc, 2002; Comakli et al. 2008; Sahinoglu, 2010). The possible reason why the ratio of P is low is that the soil in the rangeland was low in terms of P as stated in the materials and methods part.

As a result, based on the findings obtained from the research, as it is understood from the rangeland quality degree, it was concluded that these rangeland sections are weak rangeland and researches should be conducted in order to determine suitable breeding methods for the improvement of pastures. It is predicted that the collection of stones from the pastures and the removal of some invasive thorn form plants, as well as the application of grazing systems based on scientific principles to these areas, will have a positive effect on quality. In addition, although the soil in the study area does not contain significant problems in terms of productivity, it is recommended to make phosphorus supplementation to these lands if rangeland improvement and management works will be planned on these lands.

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Appendix 1. The Rangeland Quality Degrees of Different Directions and Altitudes

Türler	North	South	East	West	1704 m	1876 m	1992 m
Acantholimon acerosum	0.03	0.03	-	0.05	0.09	0.01	-
Acanthus dioscoridis	-	-	0.01	0.00	0.00	-	0.00
Achillea millefolium	0.01	-	0.01	0.01	0.01	-	0.01
Achillea schischkinii	0.01	0.01	-	0.01	-	0.02	-
Achillea vermicularis	0.06	0.10	0.07	0.12	0.09	0.11	0.07
Aegilops triuncialis	-	-	0.05	-	-	0.00	0.03
Alkanna orientalis	-	0.01	-	-	-	0.00	--
Alopecurus arundinaceus	-	-	-	0.01	0.00	0.00	-
Alyssum contemptum	-	0.00	-	-	-	0.00	-
Alyssum hirsutum	0.00	0.01	-	-	0.01	-	-
Anchusa strigosa	0.00	-	-	0.00	-		0.00
Anthemis pseudocotula	0.01	-	-	0.01	-	0.01	0.01
Asperugo procumbens	0.00	-	-	-	-	-	0.00
Asperula arvensis	0.00	0.00	0.00	-	0.00	-	0.00
Asperula xylorrhiza	-	0.00	0.03	-	-	-	0.02
Astragalus cephalotes	-	-	0.00	-	-	-	0.00
Astragalus compactus	-	-	0.01	-	-	0.01	-
Astragalus gummifer	0.14	0.35	0.19	0.21	0.31	0.36	0.04
Astragalus kurdicus	0.00	0.02	0.01	0.02	0.02	0.02	-
Astragalus lineatus var. *lineatus*	0.01	0.01	0.08	-	0.01	0.05	-
Astragalus lineatus var. *longidens*	-	-	-	0.02	0.01	0.00	-
Astragalus szovitsii	-	-	0.01	-	0.00	-	-
Avena sativa	0.03	0.02	0.00	0.01	0.05	-	-
Brassica elongata	0.00	0.00	0.01	-	0.01	-	-
Bromus danthoniae	-	0.08	-	0.01	0.04	0.02	0.02
Bromus japonicus	0.02	-	-	0.02	0.02		0.01
Bromus squarrosus	0.06	0.04	0.02	0.04	0.06	0.03	0.04
Bromus tectorum	-	-	0.02	-	0.01	-	-
Bromus tomentellus	-	0.07	0.32	-	0.03	0.06	0.16
Bunium paucifolium var. *brevipes*	0.00	-	-	-	-	0.00	0.00
Bunium paucifolium var. *paucifolium*	0.01	0.01	0.01	0.01	0.00	0.02	0.01
Bunium verruculosum	-	0.00	0.02	-	-	0.01	0.00
Carex nigra	-	0.00	-	-	-	-	0.00
Carex stenophylla	0.02	-	-	-	-	-	0.01
Centaurea behen	-	-	0.01	-	-	-	0.01
Centaurea iberica	-	0.00	-	-	-	-	0.00
Centaurea saligna	0.01	-	-	-	-	-	0.00
Cerastium glomeratum	0.02	0.02	0.00	-	0.03	0.01	-
Cerastium perfoliatum	0.01	-	0.01	0.00	0.01	-	0.01
Chardinia orientalis	0.01	0.03	-	-	0.02	0.01	0.00
Chenopodium murale	-	-	0.00	-	-	0.00	-
Cicer anatolicum	0.02	-	-	-	-	0.01	-
Convolvulus arvensis	0.00	0.01	0.00	0.03		0.02	0.02
Coronilla sp.	0.13	0.02	-	0.01	0.01	0.10	0.01
Coronilla sp.	0.04	0.11	-	0.04	-	-	0.13
Coronilla orientalis	-	0.01	0.02	0.01	0.02	0.01	0.01
Crataegus szovitsii	-	-	0.01	-	-	0.01	-
Crepis armena	-	0.16	-	-	-	-	0.12
Crepis foetida	-	-	-	0.03	-	-	0.02
Crepis sancta	0.01	0.14	0.02	-	0.02	0.03	0.07
Crepis sp.	0.05	0.01	-	0.03	0.06	0.01	0.01
Cruciata taurica	-	-	0.01	-	0.01	-	-
Cyperus rotundus	0.00	-	-	-	-	0.00	-
Dactylis glomerata	0.05	0.09	0.09	0.03	0.08	0.08	0.03
Dactylorhiza iberica	0.00	-	-	-	-	-	0.00
Echinops pungens	-	0.00	0.00	0.00	0.00	0.00	0.00
Eremurus spectabilis	0.05	0.10	0.09	0.08	0.19	0.06	0.00
Eryngium campestre	0.01	0.07	0.06	0.02	0.06	0.03	0.03
Euphorbia cheiradenia	0.00	-	0.00	-	0.00	-	-
Euphorbia denticulata	0.00	0.00	0.00	0.00	0.00	0.00	-
Euphorbia virgata	-	0.00	-	-	-		0.00
Ferula communis	0.01	-	0.02	0.01	0.01	0.02	-
Fibigia macrocarpa	-	-	-	0.00	0.00	-	-
Filago sp.	0.00	-	-	0.01	0.00	-	0.00
Gagea villosa	0.02	-	-	-	-	-	0.01
Galium aparine	-	-	0.01	0.01	0.00	-	0.01
Galium consanguineum	0.00	-	-	-	-	-	0.00
Gundelia tournefortii var. *armata*	0.00	-	-	-	-	-	0.00
Gundelia tournefortii var. *tournefortii*	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Haplophyllum armenum	-	-	-	0.00	-	0.00	-
Helianthemum ledifolium	-	-	-	0.00	-	-	0.00
Holesteum umbellatum	0.01	0.00	0.00	0.02	0.00	0.01	0.02
Hordeum bulbosum	0.57	-	0.02	0.46	0.01	0.29	0.47
Hordeum murinum	0.05	-	0.00	0.01	0.00	0.02	0.03
Hypericum scabrum	0.00	0.00	0.00	0.00	0.00	-	0.00
Hypericum triquetrifolium	0.00	-	-	-	0.00	-	-
Lallemantia iberica	0.00	-	-	0.00	0.00	-	0.00
Lamium album	-	0.00	-	0.00	0.00	-	-
Lamium macrodon	0.00	-	-	-	0.00	-	-

Linum mucronatum	-	-	0.06	-	0.04	-	-
Lotus corniculatus	0.05	-	-	0.01	-	0.01	0.04
Lotus gebelia	-	0.17	0.08	0.01	-	0.04	0.15
Medicago sp.	-	-	-	0.00	-	-	0.00
Medicago lupulina	0.00	-	-	-	-	-	0.00
Medicago sativa	-	0.02	-	-	-	-	0.02
Medicago x varia	-	-	-	0.05	-	-	0.04
Melilotus alba	-	0.01	-	-	-	-	0.01
Mentha longifolia	0.00	-	-	-	-	-	0.00
Minuartia hamata	0.00	-	0.01	0.01	-	0.01	0.00
Myosotis sp.	0.00	-	-	-	-	0.00	-
Nepeta sp.	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Nonea pulla	-	-	-	0.00	0.00	-	0.00
Onobrychis fallax	0.01	0.00	0.06	-	-	0.01	0.04
Ononis spinosa	-	-	0.01	-	-	0.00	0.00
Onosma sericeum	0.00	-	-	-	-	-	0.00
Onosma trachytrichum	-	0.00	-	0.01	0.01	-	0.00
Origanum acutidens	-	-	0.00		-	-	0.00
Origanum vulgare	-	-	-	0.00	-	0.00	-
Ornithogalum narbonense	0.04	0.00	-	-	-	-	0.03
Orobanche anatolica	-	-	0.00	-	0.00	-	-
Papaver dubium	-	-	0.00	-	-	0.00	-
Papaver rhoeas	-	0.01	0.00	-	-	0.00	0.00
Paracaryum sp.	-	-	-	0.00	-	0.00	-
Phlomis bruguieri	0.00	-	-	0.04	0.04	-	-
Phlomis linearis	0.00	0.02	0.00	0.00	0.02	0.00	0.00
Phlomis pungens	0.01	0.02	0.01	0.00	0.01	0.01	0.01
Phlomis rigida	0.01	0.02	0.00	0.00	0.01	0.02	0.01
Plantago lanceolata	0.57	0.15	0.64	0.60	-	0.76	0.64
Poa bulbosa	0.21	0.10	0.11	0.29	0.13	0.21	0.20
Poa nemoralis	0.04	-	-	0.02	0.02	0.03	-
Poa trivialis	-	0.01	0.02	-	0.01	0.01	-
Polygonum arenastrum	-	0.00	-	0.00	0.00	0.00	-
Polygonum cognatum	-	-	-	0.00	-	0.00	-
Potentilla recta	0.03	-	-	0.01	-	0.03	-
Ranunculus arvensis	0.00	-	-	0.00	-	0.00	0.00
Ranunculus cuneatus	0.01	-	-	0.01	0.01	-	0.00
Ranunculus kotschyi	-	0.01	-	-	-	-	0.00
Rhagadiolus angulosus	0.01	0.01	0.01	-	0.01	0.00	0.01
Rochelia disperma	0.00	0.01	-	-	-	0.01	0.00
Rumex acetosella	0.02	0.00	0.00	0.01	0.01	0.01	0.00
Salvia macrochlamys	-	-	-	0.00	-	-	0.00
Salvia multicaulis	-	-	-	0.00	0.00	-	-
Salvia syriaca	-	0.00	0.00	-	-	-	0.00
Salvia trichoclada	0.00	-	-	-	-	0.00	
Sanguisorba minor subsp. *lasiocarpa*	0.17	0.12	0.39	0.27	-	0.31	0.37
Sanguisorba minor subsp. *minor*	0.10	0.06		-	-	0.04	0.08
Scorzonera mollis	0.00	-	0.00	-	0.00	0.00	-
Scutellaria orientalis	-	-	-	0.01	0.00	-	-
Sedum album	0.00	-	-	-	-	0.00	0.00
Silene spergulifolia	0.00	0.00	-	0.01	0.01	0.01	-
Silene supina	-	-	-	0.00	0.00	-	-
Sisymbrium loeselii	-	-	0.00	0.00	0.00	0.00	-
Stachys lavandulifolia	-	0.03	0.00	-	0.02	-	-
Stipa holosericea	-	-	-	0.00	0.00	-	-
Taeniatherum caput-medusae	0.00	0.04	-	0.01	0.01	0.01	0.02
Thlaspi arvense	0.01	0.01	0.01	0.01	0.02	0.01	0.00
Thymus kotschyanus	0.01	0.03	0.09	0.07	0.09	0.07	-
Torilis leptophylla	-	-	0.01	-	-	-	0.01
Trifolium arvense	0.02	-	-	0.07	-	-	0.06
Trifolium campestre	0.38	0.16	-	-	-	0.00	0.39
Trifolium hirtum	0.03	-	-	-	-	-	0.02
Trifolium hybridum	0.09	-	-	-	-	-	0.07
Trifolium nigrescens	-	-	0.01	-	-	0.01	-
Trifolium pratense	0.01	-	-	0.22	-	0.06	0.10
Trigonella foenum-graecum	-	-	-	0.00	-	-	0.00
Turgenia latifolia	-	-	-	0.00	-	0.00	0.00
Tussilago farfara	-	0.00	0.00	-	0.00	0.00	-
Vaccaria hispanica var. *grandiflora*	-	-	0.00	-	-	-	0.00
Vaccaria hispanica var. *pyramidata*	-	-	0.03	-	-	-	0.02
Verbascum speciosum	-	-	-	0.00	0.00	-	-
Veronica orientalis	0.01	0.00	0.02	0.00	0.02	-	0.00
Vicia cracca	0.04	-	-	0.02	0.02	0.02	0.00
Zingeria biebersteiniana	0.04	-	-	-	-	0.02	0.01
Ziziphora capitata	0.02	0.04	0.01	0.01	0.04	0.01	0.01
Ziziphora clinopodioides	0.00	0.01	0.01	-	0.01	0.01	0.00
	3.41	2.63	2.84	3.13	1.86	3.18	3.84

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