

## Status of species richness and *Scorzonera judaica* species at four locations at Al-Shoubak region in Jordan

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### ABSTRACT

Studying species diversity is crucial for monitoring, management and *in situ* conservation of dryland agrobiodiversity. The species richness and diversity index, along with the density and frequency of *Scorzonera Judaica* (Eig) species were assessed in March/April 2015 and 2016 at Alshoubak region using transect-quadrat approach. A total of 120 quadrats within three transects at each of the four locations located at 1554-1273m altitude were assessed for species richness. A total of 17 taxa-species were identified over the two seasons. In 2015, high species richness (9 species) was found at AlShoubak-Doshk site with 1273m a. s. l., while Fujaj/Qadsiah road showed lowest species richness (3 species), corresponding respectively to highest and lowest Shannon's diversity indices of 1.602) and 0.358. In 2016, Fujaj/Qadsiah road showed the lowest species richness (4 species) but Aljhair site had the highest number of species (9). Over two years, high values of Shannon\_index H (6.90), Simpson\_1-D (3.33), Evenness\_e^H/S (3.69) and Equitability\_J (4.09) were recorded at Alshoubak-Doshk location, which showed higher number of species. The highest values were recorded by *S. judaica*, *Artimesia herba alba*, 3.51 and 3.21, respectively, while Zero value (0.00) was recorded by *Achillea fragrantissima*, *Crocus sativus*, *Lasiopogon muscoides* and *Vicia sativa*. In general, lower elevations showed higher number of species compared to higher altitudes. *Scorzonera judaica* showed the highest density and frequency values at Fujaj/Qadsiah location. Three medicinal plant species namely *A. fragrantissima*, *A. santolina* and *A. herba alba* recorded in the region are still used in the folk medicine by local communities.

**Keywords:** density, frequency, yellow Viper's grass, *Scorzonera judaica*, species richness.

### INTRODUCTION

*Scorzonera judaica* (Eig), known as yellow Viper's grass is a perennial herb found in dry and desert areas in Jordan (Azraq, Eastern desert, Tafila, Shoubak, Maan and Ras an-Naqab) and flowers during March to May (Al-Esawi, 1998). Rural people consume the tubers after eliminating the toxic milk constituent by roasting. Nine new phenolic compounds, such as 3S-hydrangenol 40-O-R-L-rhamnopyranoyl-(1f3)-β-D-glucopyranoside were identified in *Scorzonera judaica* (Badar *et al.*, 2011). Colling & Matthies (2006) reported that most of the remnant populations of *Scorzonera humilis* are highly threatened along with other plant species. The biodiversity conservation by promoting *in situ* conservation and management of natural habitats (Croce, 2015). Abu-saief, (2013) pointed out that the species richness and Shannon index increased during spring and winter, and he found an inverse relationship between species richness and diversity. Overgrazed sites showed significantly lower species richness compared to protected areas (13 vs. 15 species per quadrat) as well as lower equitability (0.39 vs. 0.42) (Papanastasis *et al.*, 2002). Overgrazing has drastically increased unpalatable species and contributed to desertification over vast areas (Al-Sodany *et al.*, 2013). Frequency is the percentage of quadrates in which a species was recorded and density is defined as the number of plants of individual species per

unit area. Generally, species diversity is one of the most important indices used to evaluate an ecosystem (Ndah *et al.*, 2013). An increase in species diversity was observed during spring and summer seasons and declined in autumn and winter (Shameem & Kangaroo, 2011). Little work has been done to assess plant diversity at AlShoubak region in Jordan. This study aims at assessing the species richness and the status of *Scorzonera judaica* at AlShoubak region in Jordan.

### MATERIALS AND METHODS

#### Study area

The study was conducted at Alshoubak region located in the southern part of Jordan, characterized by cold winters and very hot summers. Four locations were identified based on the presence of *Scorzonera judaica* (Table 1 and Fig. 1) to conduct the botanic survey. Three transects of 50 m length each were established with a total of 15 quadrats with an area (0.5mx0.5m) each. The botanic survey (number of plant species, density and frequency) was conducted in the quadrats during the end of March to April in 2015 and 2016. The number of individuals and occurrence of each species in the quadrats were then used to calculate different species diversity indices. The elevation, latitude, and longitude were collected at each study site using handheld GPS meter (Garmin).

**Table 1.** Coordinates and diversity indices of *Scorzonera judaica* at four locations during 2015 and 2016.

Coordinates	2015				2016			
	Alshoubak/ Doshk	Alshoubak/ Abu-eid	Alshoubak/ Aljhair	Fujaj/ Q a d s i a h road	Alshoubak/ Doshk	Alshoubak/ Abu-eid	Alshoubak/ Aljhair	Fujaj/ Q a d s i a h road
N°	30 31.351	30 31.500	30 32.765	30 33.144	30 31.351	30 31.500	30 32.765	30 33.144
E°	035 37.014	035 33.281	035 31.198	035 37.670	035 37.014	035 33.281	035 31.198	035 37.670
Elevation (m)	1273	1420	1554	1275	1273	1420	1554	1275
	2015 Diversity indices				2016 Diversity indices			
Species richness	9	5	5	3	6	5	9	4
Taxa S	9	5	5	3	6	5	9	4
Individuals	58	306	218	279	129	42	101	19
Dominance_D	1.67	2.46	3.17	2.69	2.29	1.83	2.22	1.7
Shannon_H	6.90	5.28	3.79	5.18	5.34	4.68	5.64	5.77
Simpson_1-D	3.33	2.54	1.83	2.32	2.71	3.17	2.78	3.3
Evenness_e^H/S	3.69	2.41	2.28	2.40	3.46	4.40	3.14	4.89
Equitability_J	4.09	2.91	2.38	2.68	3.52	4.43	3.54	4.89



**Figure 1.** Photo of *Scorzonera judaica* found at Alshoubak region in Jordan.

**Data analysis**

Species richness was estimated as the number of the species found in the quadrat and allowed to quantify the diversity of the plant species using Shannon index (*H'*) measuring species abundance and richness. Plant density (total number of plant for a given plant species/total number of quadrats studied x100) and frequency (number of quadrats in which species occurs/total number of quadrats studied x100) were calculated according to Rajan (2001). Qualitative and quantitative diversity indices such as Shannon, Taxa\_S, Dominance, Simpson and Equitability were determined using the PAST software program ver. 2.18c (Hammer *et al.*, 2001).

**RESULTS**

The botanic surveys showed that *Scorzonera judaica* species is distributed within the elevation ranging from 1554 to 1273 m a. s. l. (Table 1). The assessment of the plant species diversity during 2015 year pointed that

Doshk site showed high values of species richness (9), Shannon\_H (6.90), Simpson\_1-D (3.33), Evenness\_e^H/S (3.69) and Equitability\_J (4.09), but showed the lowest value of Dominance\_D 1.67 (Table 1). During the same year Fujaj site had the lowest species richness (3), Aljhair showed the lowest value of Shannon\_H (3.79), Simpson\_1-D (1.83) and Equitability\_J (2.38) indices (Table 1), but had the highest value of Dominance\_D (3.17). In 2016 year, Aljhair had high species richness (9), followed by Doshk (6), Abu-eid (5) and Fujaj (4) (Table 1). Doshk site recorded the highest value of Dominance\_D (2.29), Fujaj had high value of Shannon\_H (5.77), Equitability\_J (4.89) and Simpson\_1-D (3.17) and Evenness\_e^H/S (4.89), and Abu-eid had lowest value of

**Table 2.** Presence and absence of plant species within studied area.

No.	Botanical name	2015	2016
1	<i>Achillea fragrantissima</i>	+	-
2	<i>Achillea santolina</i>	-	+
3	<i>Anabasis syriaca</i>	+	+
4	<i>Artemisia herba-alba</i> Asso.	+	+
5	<i>Anthemis tinctoria</i>	-	+
6	<i>Avena sterilis</i>	-	+
7	<i>Centaurea</i> sp.	-	+
8	<i>Crocus sativus</i>	+	-
9	<i>Cynodon dactylon</i>	+	-
10	<i>Hordeum</i> sp.	-	+
11	<i>Hordeum vulgare</i>	+	+
12	<i>Lactuca orientalis</i> ( Boiss.) Boiss	+	-
13	<i>Lasiopogon muscoides</i>	+	+
14	<i>Noaea mucronata</i>	+	+
15	<i>Scorzonera judaica</i>	+	+
16	<i>Sinapis arvensis</i>	-	+
17	<i>Vicia sativa</i>	+	-
Total number of plant species		11	12

**Table 3.** Diversity indices of plant species during 2015 and 2016 at four sites at Alshoubak region where *Scorzonera judaica* is found.

2015		Botanical name										
Diversity indices	<i>S. judaica</i>	<i>C. dactylon</i>	<i>C. sativus</i>	<i>A. herba alba</i>	<i>N. mucronata</i>	<i>L. orientalis</i>	<i>A. syriaca</i>	<i>A. fragrantissima</i>	<i>H. vulgare</i>	<i>L. muscoides</i>	<i>V. sativa</i>	
Taxa_S (quadrate with species)	40	32	1	25	10	2	3	1	2	1	1	
Individuals	56	725	1	26	19	2	3	3	11	1	1	
Dominance_D	0.04	0.09	1	0.04	0.26	0.5	0.33	1	0.50	1	1	
Shannon_H	3.51	2.75	0	3.21	1.83	0.69	1.10	0	0.69	0	0	
Simpson_1-D	0.96	0.91	0	0.96	0.74	0.5	0.68	0	0.50	0	0	
Evenness_e^H/S	0.84	0.49	1	0.99	0.62	1	1	1	1	1	1	
Equitability_J	0.95	0.79	-	1	0.80	1	1	-	0.99	-	-	
2016		Botanical name										
Diversity indices	<i>S. judaica</i>	<i>Centurea</i> sp.	<i>A. syriaca</i>	<i>Hordeum</i> sp.	<i>H. vulgare</i>	<i>A. herba alba</i>	<i>N. mucronata</i>	<i>A. santolina</i>	<i>A. tinctoria</i>	<i>L. muscoides</i>	<i>A. sterilis</i>	<i>Sarvensis</i>
Taxa_S (quadrate with species)	20	10	3	6	2	31	5	2	2	1	1	1
Individuals	21	21	3	72	15	39	6	45	3	30	1	1
Dominance_D	0.05	0.15	0.33	0.36	0.56	0.04	0.22	0.51	0.56	1	1	1
Shannon_H	2.98	2.07	1.10	1.17	0.64	3.35	1.56	0.69	0.64	0	0	0
Simpson_1-D	0.95	0.85	0.67	0.64	0.44	0.96	0.78	0.49	0.44	0	0	0
Evenness_e^H/S	0.98	0.79	1	0.54	0.95	0.92	0.95	0.99	0.95	1	1	1
Equitability_J	0.99	0.90	1	0.65	0.92	0.98	0.97	0.99	0.92	-	-	-

Shannon –H (4.68). The total number of plant species overall the studied sites were 11 and 12 during 2015 and 2016, respectively (Table 2). Three medicinal plants were registered namely *Achillea fragrantissima*, *Achillea santolina* and *Artemisia herba alba* which are used in the folk medicine locally. Diversity indices for vegetation cover were measured (Table 3). *Scorzonera judaica* showed the highest Taxa\_S and individuals with 40 and 56 respectively in 2015 and 20 and 21 respectively in 2016. In 2015, *S. judaica* showed 0.04 Dominance\_D, 3.51 Shannon\_H, 0.96 Simpson\_1-D, 0.84 Evenness\_e^H/S and 0.95 Equitability\_J, while in 2016 it had the respective values of 0.05, 2.98, 0.95, 0.98 and 0.99 (Table 3). Shannon\_H index ranged from 0.00 to 3.51 with the highest values recorded for *S. judaica*, *A. herba alba*, 3.51 and 3.21, respectively, while Zero value (0.00)

was recorded for *Achillea fragrantissima*, *Crocus sativus*, *Lasiopogon muscoides* and *Vicia sativa* which showed highest values of Dominance\_D (Table 3). The highest values for Simpson\_1-D index of 0.96 were recorded by *Scorzonera judaica* and *Artemisia herba alba*, while the lowest values were recorded by *A. fragrantissima*, *C. sativus*, *L. muscoides* and *V. sativa*. *C. sativus*, *L. muscoides* and *V. sativa*, *Hordeum vulgare* and *Anabasis syriaca* showed high Evenness\_e^H/S value (1.00), and *C. dactylon* had the lowest value (0.49) and the lowest Equitability\_J value of 0.79 (Table 3). In 2016, the highest value of Shannon\_H (3.35) and Taxa\_S (20) were recorded for *Artemisia herba alba*. Lowest zero value was recorded for *L. muscoides*, *Avena sterilis* and *Sinapis arevensis* (Table 3) which also showed the highest Simpson\_1-D and Dominance\_D values (1.00) and the

**Table 4.** Density and frequency of plant species at four sites at Ma'an governorate during 2015.

Alshoubak-Doshk-2015			Alshoubak/Abu-eid-2015			Alshoubak /Aljhair-2015			Fujaj/ Qadsiah road -2015		
Species	Density	frequency	Species	Density	frequency	Species	Density	frequency	Species	Density	frequency
<i>Achillea fragrantissima</i>	0.07	0.07	<i>Artemisia herba-alba Asso</i>	0.60	0.060	<i>Achillea santolina</i>	0.80	0.13	<i>Artemisia herba-alba Asso</i>	2.6	0.47
<i>Anabasis syriaca</i>	0.33	0.20	<i>Cynodon dactylon</i>	0.27	0.47	<i>Artemisia herba-alba Asso</i>	0.60	0.60	<i>Cynodon dactylon</i>	14.8	0.93
<i>Cynodon dactylon</i>	1.47	0.27	<i>Lactuca orientalis (Boiss.) Boiss</i>	0.07	0.07	<i>Crocus sativus</i>	0.07	0.07	<i>Scorzonera judaica</i>	1.13	0.8
<i>Hordeum vulgare</i>	0.73	0.13	<i>Noaea mucronata</i>	1.07	0.47	<i>Cynodon dactylon</i>	11.33	0.40			
<i>Lactuca orientalis (Boiss.) Boiss</i>	0.07	0.07	<i>Scorzonera judaica</i>	1.07	0.73	<i>Scorzonera judaica</i>	0.67	0.40			
<i>Lasiopogon muscoides</i>	0.07	0.07									
<i>Noaea mucronata</i>	0.27	0.27									
<i>Scorzonera judaica</i>	0.73	0.73									
<i>Vicia sativa</i>	0.07	0.07									

lowest values (0.00) for Shannon\_H and Simpson\_1-D indices. The high value (1.00) of Equitability\_J was recorded for *A. syriaca*. The results of density and frequency analysis during 2015 and 2016 are included in Tables 4 and 5 respectively. In 2015, high density and frequency values (1.13 and 0.80) were recorded for *Scorzonera judaica* at Alfujaj site, while in 2016 Doshk had the highest values (0.60 and 0.53), respectively. Among the studied species, *Cynodon dactylon* showed high values of density and frequency at Fujaj (14.87 and 0.93) followed by Aljhair (11.33 and 0.40) in 2015 season (Table 4). *S. judaica* had lowest values of density and frequency at Aljhair (0.67 and 0.40) in 2015 (Table 4). During 2016, *S. judaica* showed the highest values for density and frequency at Doshk (0.60 and 0.53) followed by Aljhair (0.33 and 0.33) then Abu-eid and Fujaj (0.27 and 0.13) (Table 5). Among plant species the density and frequency values for *Artemisia herba alba* were 0.80 and 0.67 at Abu-eid, 0.80 and 0.67 at Aljhair site and 0.80 and 0.13 at Fujaj site, respectively (Table 5) while *Hordeum* species. had 6.27 for density and 0.33 for frequency.

## DISCUSSION

The high frequency and density recorded for *Hordeum* sp. and *Cynodon dactylon* indicated the high adaptation of these species to harsh environments and their limited effect by livestock grazing. The diversity index is one measure ecologists use to quantify species diversity to compare different environments and to assess changes over time (Abusaief, 2013). Genetic diversity estimation uses multiple quadrats to assess herbaceous plant density. Transects are selected randomly and the quadrats

were placed systematically along each transect to provide baseline information on species diversity, densities and frequencies. In our study density analysis was deliberated to sample within-limited area variation and measure changes in plant species density over time and space. Decreasing of vegetation density during this study could result of anthropogenic activities such as road construction, human interfering and climate change particularly rainfall vibrations from year to year. Compared between years, the absence of certain species in 2015 and present in 2016 or vice versa this may be due to grazing or it was not covered or recorded in the randomly laid quadrats. Ndah *et al.*, (2013) pointed that the stem density of tree species decreased was resulted from construction and deforestation of forest for plantation crops. High values of dominance showed the lower species diversity and more obvious at higher elevations such as Aljhair 1554m. we concluded that continuous grazing and human collection resulted in decrease of cover percentage of *Artemisia* and *Achillea* species. Zarekia *et al.*, (2013) mentioned that continuous grazing throughout the year had negative effect on species composition and production. Variation in quantitative parameters like, species richness and species diversity is related to variations in edaphic factors, elevation, slope aspect, grazing and micro-climatic conditions between studied sites (Shameem and Kangroo, 2011). Compared to the lower elevations to the higher altitudes showed lowest number of plant species and the diversity were decreased with increase the elevations. Kumar and Sharma, (2013) reported that the altitudinal distribution of the medicinal plants species in the study area shows the highest number of 199 species in the lower most inhabited altitudinal zone of 1800-2800m a. s. l. followed by 166 species in the middle sub-alpine

**Table 5.** Density and frequency of plant species at four sites at Ma'an governorate during 2016

Alshoubak-Doshk-2016			Alshoubak/Abu-eid-2016			Alshoubak /Aljhair-2016			Fujaj/ Qadsiah road -2016		
Botanical name	Density	Frequency	Botanical name	Density	Frequency	Botanical name	Density	Frequency	Botanical name	Density	Frequency
<i>Anabasis syriaca</i>	0.20	0.20	<i>Artemisia herba-alba</i> Asso.	0.80	0.67	<i>Achillea santolina</i>	1.67	0.067	<i>Artemisia herba-alba</i> Asso.	0.80	0.13
<i>Artemisia herba-alba</i> Asso.	0.067	7	<i>Hordeum sp. (redcolor)</i>	0.067	7	<i>Anthemis tinctoria</i>	0.2	0.13	<i>Hordeum sp. (redcolor)</i>	0.067	7
<i>Centaurea sp.</i>	0.40	0.20	<i>Noaea mucronata</i>	0.13	0.13	<i>Artemisia herba-alba</i> Asso.	0.80	0.60	<i>Noaea mucronata</i>	0.13	0.13
<i>Hordeum sp. (redcolor)</i>	0.33	0.33	<i>Scorzonera judaica</i>	0.27	0.13	<i>Avena sterilis</i>	0.067	7	<i>Scorzonera judaica</i>	0.27	0.13
<i>Hordeum vulgare</i>	0.13	0.13				<i>Centaurea sp.</i>	0.87	0.40			
<i>Scorzonera judaica</i>	0.60	0.53				<i>Hordeum sp. (redcolor)</i>	0.67	0.13			
						<i>Lasiopogon muscoides</i>	2.0	0.067			
						<i>Sinapis arvensis</i>	0.067	7			
						<i>Scorzonera judaica</i>	0.33	0.33			

altitudinal zone of 2800-3500m a. s. l. and 95 species in the high altitudinal alpine zone of 3500-5000m a. s. l. *Scorzonera judaica* density was varied between studied years because this kind of species is consumed by local communities which influence on its distribution among locations. Monitoring and establishing management plant to conserve the genetic resources in the wild areas is needed to keep the resources for present and next generations in the future.

**REFERENCES**

Abusaief, H. M. A. 2013. Habitats and plant diversity of Al Mansora and Jarjr-oma regions in Al- Jabal Al-Akhdar- Libya. Life Sci J. 10 (2): 659-692

Al-Esawi, D. M. H. 1998. Field guide to wild flower of Jordan and neighboring countries. Al-Rai publishing company, Amman. Jordan.

Al-Sodany, Y. M., Bazaid, S.A. and Mosallam, H.A. 2013. Medicinal Plants in Saudi Arabia: I. Sarrwat Mountains at Taif, KSA. Academic Journal of Plant Sciences 6 (4): 134-145.

Badar, A. N. De T., Cotugno, R. and Braca, A.. 2011. Phenolic compounds from the roots of Jordanian Viper's grass, *Scorzonera judaica*. The Journal of Natural Products. 74, 1421-1426. dx.doi.org/10.1021/np200143s /J. Nat. Prod.

Colling, G. and Matthies, D. 2006. Effects of habitat deterioration on population dynamics and extinction risk of endangered, long-lived perennial herb

(*Scorzonera humilis*). Journal of Ecology 94: 959-972.

Croce, A. 2015. Vascular flora of eight water reservoir areas in southern Italy. Check List the Journal of Biodiversity Data 11(2):1-23. doi: http://dx.doi.org/10.15560/11.2.1593.

Kumar, S. and Sanjay Sharma. 2013. Species diversity, uses and distribution of medicinal plants along an altitudinal gradient in Paddar valley, Northwestern Himalaya. Int. J. Med. Arom. Plants 3(3):343-351

Ndah, N.R., Andrew, E. E. and Bechem,E. 2013. Species composition, diversity and distribution distributed Takamanda rainforest, South West, Cameroon. African Journal of Plant Science 7(12): 677-585

Papanastasis,V. P., Kyriakakis, S. and Kazakis, G. 2002. Plant diversity in relation to overgrazing and burning in mountain Mediterranean ecosystem. Journal of Mediterranean Ecology 3(2-3): 53-63

Shameem, S. A. and Kangroo, I.N. 2011. Comparative assessment of edaphic features and phytodiversity in lower Dachigam National Park, Kashmir Himalaya, India. African Journal of Environmental Science and Technology 5(11): 972-984

Zarekia, S., Arzani, H., Jafari ,M., Javadi,S.A., Jafari, A.A. and Esfahan, E.Z. 2013. Change of vegetation structure and biomass in response to the livestock grazing in Steppe range lands of Iran. The Journal of Animal and Plant Science 23(5):1466-1472.