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Species diversity and genetic diversity of *Paronychia argentea* Lam. at Jerash and Wadishueib ecosystems in Jordan

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Abstract

Jordan's flora is plenty and highly miscellaneous. Species diversity is one of the essential indices used for determining the sustainability of herbaceous, shrubs and trees communities. This study was conducted during three years consequences from 2009-2012, and it aims to estimation and monitoring the genetic diversity among certain *Paronychia argentea* species at different sites in Jordan. The plant species were sampled by transect-quadrate method using square wood quadrate. Species richness, density Shannon and Simpson indices were applied to quantify of the diversity among target studied sites. Species richness, frequency and Shannon's diversity values among studied areas and years were recorded during the year of 2011/2102. High species richness (50 and 51) was found at Jerash for both sites compared to the wadishueib regions. High number of taxa was recorded at higher elevations compared to lower elevations particularly during the year 2012 compared to the rest years. Asteraceae, fabacaea and poaceae showed the most frequent families during this study. Studying the species richness, density, frequency and monitoring are crucial measurements for management and conservation of plant communities either *in situ* or *ex situ.*

Keywords: Jordan, monitoring, *Paronychia*, richness.

Introduction:

Jordan's flora is plenty and highly miscellaneous. Around 2,600 species of vascular plants belonging to 152 families and about 700 genera, representing about 1% of the total flora of the world have been recorded at Jordan. One hundred species are endemic, (including species of the genus *Crocus, Colchicum, Iris* and *Verbascum*), 375 are rare or very rare (including species of the genus *Orchis, Romulea, Biarum* and *Globularia*), forming about 2.5% of the total flora of Jordan, which is considered high in world standards (Al-Esawi, 1996; Al-Esawi and Oran, 1995). *Paronychia argentea* Lam. is one of the herbal and a medicinal plant, grown in Jordan along with other medicinal and herbal plants used in folk medicine, was recorded at Ajlun (Al-Quran, 2011), possessing flavonoids and phenolics phytochemical compounds with a significant antibacterial effect (Abuhamdah *et al*., 2013). Also, Oran (2005) and Oran (2014) recorded palatable and medicinal plant species like *Paronychia argentea* Lam., *Achillea fragrantissima* and *Artemisia herba alba* at Wadi Musa/ Petra and Tafila at Jordan. Al-Esawi (1998) described the *Paronychia aregentea* as a perennial herb, with stems speading on the ground. Leaves 0.5-1cm long, oblong-elliptic, with sharp ends and rough margins, surrounded by dense, hyaline stipules. Flowers usually minute, arranged in heads of 1 cm in diameter, surrounded by hyaline bracts. Habitat: waste places of mountains; Irbid, Ajloun, Jarash, Amman, Karak, Tafila and Mafraq. Fl. Fe-May. Abusaief and Dakhil (2013) recorded the *Paronychia argentea* Lam. species at Al Mansora in Al-Jabal Al-Akhdar-Libya; at Californa (Julian, 2012); at Akhanasira range reserve of Jordan by (Alhamad, 2006), in Spain (Benítez *et al*., 2010). Crop wild relatives are crops that are not directly associated with our food sources but they have a sources of genetic material that can be utilized as species of scoio-economic potential such as a medicinal and aromatic species in which *Paronychia argentea* amongst them. Species richness, species relative abundance and heterogeneity of their spatial or temporal distributions in a given area are the central subjects of community ecology (He and Legendre, 2002). Species richness is the most widely used measure for the diversity of biological community (Kéry and Schmid, 2006 and Ren-zhong, 2002). Jordan covers an area of 89.000km^2, 90% of which is arid rangeland receiving less than 200mm of annual rainfall. Rangeland in Jordan has been deteriorating as a result of long-term abuses such as overgrazing, cultivation and collecting medicinal and aromatic plants, resulting in plant cover deterioration and loss of biodiversity (Alhamad, 2006). Biodiversity can be defined as the variation in all living things at the all levels (Campbell, 2003). Biodiversity measurement

typically concentrated on the species level and species diversity. Plant species diversity can be measured by species richness, evenness and Shannon's diversity index (Ejtehadi *et al*., 2007); Shannon and Weaver, (1949); Naqinezhad *et al*. (2010) and Rad *et al*., 2009). In recent times, the ability to predict plant species richness at the regional level has improved owing to the availability of satellite derived biophysical variables from sensors such as NASAs Moderate Resolution Imaging Spectro radiometer (MODIS) (John *et al*. 2008). There were strong positive, pair wise relationships between species richness, reserve are and habitat diversity (Pyšek *et al*. 2002). Several studies indicate the highest or lowest species richness appears at the mid-altitudinal zones. The maximum species density appeared between 1800m and 2000m a.s.l. (Wang *et al*., 2007). Hannus and Numers, (2008) pointed that species richness was significantly associated with both island area and habitat diversity. Species frequency and density are efficient expressions for revealing the spatial distribution of species and numerical strength of a species present in the landscape (Alhamad, 2006). Species diversity is a crucial nutrient sources for people, animals and economic insects such as bees in which *Paronychia* genus become a host for them. de Bello *et al*. (2006) found that the species diversity was lowest in water-stressed environments (arid locations and southern aspects) and increased with grazing more markedly in humid locations. Julian (2012) reported that bee species richness and abundance increased in landscapes dominant by cover of native vegetation, in particular, to cover of the resource-rich plant *Paronychia argentea*. Behera *et al*. (2007) stated that biodiversity and disturbance are hierarchical concepts; disturbance can be considered as a basic process responsible for many other processes, such as fragmentation, migration, local and regional extinction. Climate change one of the greats factors effect on the people and regions, mitigating strategies are needed to protect the poorest and local regions. Future changes in precipitation regimes are likely to impact species richness in water-limited plant communities (Adler and Levine, 2007). There are several factors impact observed species richness-altitude pattern in which area is among of these factors (Wang *et al*., 2007). The climatic variables, including temperature, rainfall and relative humidity, affect the phonological niches and between-species differences; within–species variations occurred between years and there were no between-site variation for most study species (Hegazy *et al*., 2012). The traditional knowledge should be appreciated in resolving new policies or reforming current policy and legislation related to the conservation biodiversity and the utilization of neglected species (Al-Qura'n, 2012). So far, no research has been done to indicate and evaluate the plant diversity for *Paronychia argentea* species in Jordan; therefore the aim of this study was conducted to identify the species richness and other measurements of diversity for this species.

Material and methods

Study area

This research was carried out during spring of 2009-2012 at two sites within both governorates (As-salt and Jerash) were located at the middle and north of Jordan, respectively. The coordinates of target sites shown at the (Table 1). The study areas were sampled using transect-quadrat method based on sampling unit (square wood quadrat) with an area 0.5m x0.5m as described by (Julian, 2012; and Oesterheld and Oyarzábal, 2004). Three line transects were laid out perpendicular chosen start point with a five quadrats per transect. The initial quadrat location was selected randomly. The transect length was 50 meters length, per each 10m the number of species within the quadrat was identified and recorded then placement on the excel sheet. Species richness was counted as the number of species per quadrat. All plant species were identified to genus and to species. Geographical positions of the quadrats were obtained by using GPS.

Table 1: Species richness for *Paronychia argentea* studied at two governorates in Jordan.

Location	Year			Coordinates		Elevation (m)
	2009/2010	2010/2011	2011/2012			
Wadishueib/Hsmah	25	25	24	E:03544.609	N:3157.708	457
Wadishueib/Ramleh	17	17	33	E: 03544.609	N: 3157.785	569
Jerash/ beside University site	28	41	50	E:03553.949	N:3215.548	561
Jerash/Hussinat	32	47	51	E :035 480.867	N 32 15.692	1104

Data analysis and measuring plant diversity

Species richness was estimated as the number of the species found in the quadrate. To quantify the diversity of the plant species, the Shannon index (*H*') as a measure of species abundance and richness applied. The data for each site were analyzed separately. Excel program 2007 was used in the organization and presentation of data statistically. Density calculated according to Ambasht, (1982); frequency measured based on Rajan, (2001). PAST software program ver. 2.18c (Hammer *et al*., 2001) was used to analyze the data.

Results:

The present-day vegetation of the surrounding of the studied area at Wadishueib and Jerash is dominated by agriculture, mainly cereal fields, forest trees and olive orchards. Species richness and coordinates of target sites depicted at Table 1. Species richness for Wadishueib /Hsmah increased by year. During 2009/2010, 2010/2011 and 2011/2012 the number of species increased, 25, 26 and 25, respectively (Table 1). Also, Wadishueib/Ramleh site showed increment of species, 17, 17 and 33. On the other hand, Jerash location showed high number of species, 28, 41, 50 during 2009/2010, 2010/2011 and 2011/2012 (Table 1 and 2) as well Hussinat site have 32, 47 and 51 for2009/2010, 2010/2011 and 2011/2012, respectively (Table 1 and 2). Diversity among and within locations was increased by year and elevation (Table 1 and 2). High species richness was recorded during year 2011/2012 over all sites. Species richness showed highly correlated with elevation, high elevated sites registered rising values of species richness for example Wadishueib/Ramleh with 569 m elevation showed 33 species compared to Wadishueib/Hsmah 31 species. At Jerash governorate, Hussinat site listed 51 species compared with University site 50 species (Table 1). Diversity indices were illustrated at the (Table 2). Shannon's diversity index s recorded during three years (2009/2010, 2010/2011 and 2011/2012) to the Ramleh and Hsmah as follows 2.371, 2.841, 2.660 and 2.534. 2.702 and 2.178, respectively (Table 2). For Jerash studied area beside university and Hussinat the Shannon's diversity index was 2.871, 3.048, 3.075 and 2.198, 2.954 and 2.816, respectively (Table 2). On the other hand, several qualitative and quantitative diversity indices such as Dominance, Simpson, Menhinick, Marglef, Equitability, Fisher's alpha and Berger-Paker were analyzed and depicted at (Table 2).

Table 2: Diversity indices of *Paronychia argentea* Lam. of Wadishueib sites.

Diversity indices	Wadishueib/ Ramleh			Wadishueib/Hasmah		
	2009/2010	2010/2011	2011/2012	2009/2010	2010/2011	2011/2012
Taxa_S	17	17	33	25	25	24
Individuals	258	157	424	259	177	354
Dominance_D	0.123	0.101	0.120	0.117	0.100	0.207
Shannon_H	2.371	2.481	2.660	2.534	2.702	2.178
Simpson_1-D	0.877	0.899	0.880	0.883	0.890	0.794
Evenness_e^H/S	0.630	0.703	0.433	0.504	0.573	0.368
Menhinick	1.058	1.357	1.603	1.553	1.954	1.276
Margalef	2.881	3.164	5.290	4.319	4.830	3.919
Equitability_J	0.837	0.876	0.761	0.787	0.830	0.685
Fisher_alpha	4.085	4.845	8.364	6.827	8.404	5.819
Berger-Paker	0.190	0.178	0.285	0.189	0.243	0.411
Diversity indices	Jerash/ beside university site			Jerash/ Hussinat		
	2009/2010	2010/2011	2011/2012	2009/2010	2010/2011	2011/2012
Taxa_S	28	41	50	32	47	50
Individuals	189	415	547	441	474	916
Dominance_D	0.083	0.067	0.078	0.176	0.085	0.085
Shannon_H*	2.817	3.048	3.075	2.198	2.954	2.816
Simpson_1-D*	0.917	0.933	0.922	0.824	0.915	0.915
Evenness_e^H/S	0.597	0.514	0.433	0.282	0.408	0.334
Menhinick**	2.037	2.013	2.087	1.524	2.159	1.652
Margalef**	5.151	6.635	7.713	5.091	7.466	7.185
Equitability_J	0.845	0.821	0.786	0.634	0.767	0.720
Fisher_alpha*	9.085	11.290	13.170	7.928	12.960	11.36
Berger-Paker	0.185	0.147	0.179	0.320	0.167	0.160

*Diversity value; ** Richness value

All plant species come across on their transects are listed in (Tables 3, 4, 5 and 6). A total of 141 plant species were recorded from the wadishuieb study area (Table 3 and 4), of which 67 found at Ramleh and 74 at Hsmah

site during three years. The totals of individuals were 839 and 690 at Ramleh and Hsmah, respectively (Table 3 and 4). At Jerash, the total plant species were 119 and 129 beside university site and Hussiant regions with total individuals 1151 and 1825, respectively (Table 5 and 6). The most frequent families recorded during this study was Asteraceae, fabaceae and Poaceae (Figure 1 and 2). The density and frequency of *Paronychia argentea* Lam. at both sites of wasdisheuib during 2009/2010, 2010/2011 and 2011/2012 (Table 3) were recorded at Ramleh 1.20, 1.867 and 3.20; for frequency was 0.53, 0.67 and 0.67. The *Agelopis peregrina* speices as wild type of wheat showed the highest density value (3.2) but *Ononix natrix* and *Agelopis vavliovii* recorded the lowest values (Table 3) during 2009/2010. During 2010/2011 and 2011/2012 the highest density value was registered by *Centurea sp*. (1.867) and *Poa bulbosa* (3.00), respectively, but the highest frequency value was (0.33) for *Hordeum glaucum (=marinum)* and *Anthemis palaestina*, *Poa bulbosa* (0.47) respectively (Table 3). While the density value at Hsmah site was 3.267, 2.867 and 9.667 and frequency, 0.867, 0.267 and 0.867for 2009/2010, 2010/2011 and 2011/2012, respectively (Table 4). *Lous* sp.; *Poa Bulbosa* and *Anthemis palaestina* showed the highest density values, 1.33,1.00 and 1.80 to the three years consequences, respectively (Table 4) while the frequency of *Poa Bulbosa* and *Medicago radiata* were 0.467 ; 0.800 and *Sinapis alba,* respectively. For Jerash governorate, density value of *Paronychia aregentea* was 0.733, 1.667 and 0.33 with frequency 0.467; 0.400 and 0.267, for studied three years, respectively (Table 5). Highest density values among species recorded for *Anthemis palaestina* (2.333); *Bromus fasciculatus* (1.667) during 2009/2010; *Bromus fasciculatus* (4.06), *Malva* sp (3.067) and *Hordeum glaucum= marinum* (2.067) for 2010/2011, while the highest values of density during 2011/2012 was to the *Bromus fasciculatus* (5.800); *Bromus fasciculatus* (3.067); *Hordeum glaucum= marinum* (2.467) and *Filago pyramidata* (1.667) (Table 5). The frequencies values were 0.67 and 0.533 to the *Avena sterilis,* and *Sarcopoterium spinosum* (Table 5); *Bromus fasciculatus* (4.067); *Erodium malacoides* (0.33) during 2010/2011; 0.467, 0.333 and .040 for *Hordeum glaucum = marinum Ranunculus millefolius* and *Bromus fasciculatus*, respectively (Table 5). In Hussiant site at Jerash, the density of *Paronychia aregentea* was 0.40 for all studied years (Table 6) while the frequency was 0.33 also during the same period (Table 6). High density values were for *Anthemis palaestina* , *Bromus fasciculatus* and *Avena sterilis*, 0.600, 0.400 and0.600 during 2009/2010, 2010/2011and 2011/2012, respectively (Table 6).

Discussion

The topographical diversity of Jordan, which creates varied ecological conditions within a limited area contributed to wealth of diversity. The diversity can be studied with various indices including number of species per unit area (species richness) or the Shannon index among them. Natural wild fields are plenty in terms of biological diversity. For the analysis of change in species richness along the altitude gradient Table 1. Emerges that, over 260 taxa of plant species recorded in the locations of mountains summit. Among Hsmah and Ramleh summits there is a rise of 112 m and a reduction in the species number, also between university border and Hussinat sites there is a rise of 543m a reduction in the species richness number observed over all three monitoring years. In the Apline of Italy, Stanisci *et al*. (2005) found among the Mt. Femmina Morta and Mt. Macellaro summits there is a rise of 230m and 37.3% reduction but the species number decreased of 50%. They reported that in the lowest summits (FEM and MAC) the highest vegetation cover and species richness occur in the warmest aspect, whereas at North and West the values are lower. In this study, species richness showed highly correlated with elevation were high elevated sites registered rising values of species richness. Wang *et al*. (2007) reported that analysis of generalized linear model depicted the area of each elevational band was always in high correlation with the species richness. This study confirmed that the elevations are a crucial factor to determine the biodiversity patterns regarding of species richness and abundance. The maximum species density appeared between 1800m and 2000m a.s.l. (Wang *et al*. 2007). High species richness may be related to high moisture and low temperature in the north aspect (Ejtehadi *et al*. 2007). Asteraceae, poaceae and fabaceae were the most dominant families observed during this study which is indicating that those are highly adaptability to the climatic conditions. Changes in species composition and diversity are the inevitable consequences of climate change, as well as land use and land cover change (John *et al*. 2008).The diversity decrease with increasing dominance of *Fagus orientalis* along order of the communities *Carpineto –Fagetum*, *Rusco-Fagetum* and *Fagetum oriental* (Rad *et al*. 2009). However, restoring and filling areas gaps by seeds of them will sharing in the *in situ* conservation that lead to the increasing livestock's. At Alkhanasira range reserve of Jordan. Alhamad (2006) registered a total of 93 vascular plant taxa belonging to 78 genera and 26 families. The findings pointed to the adaptation of plant taxa to livestock grazing to the small spatial. In addition to the overexploitation and grazing impact species mainly during March to early of May, the variation between years is directly related to the differences in rainfall amounts and distribution between the seasons of the study. On the other hand, it may be the quadrats were used not included the species. Establishment reserved areas within regions will reduce the negative impact on species availability and increase their numbers. Saoub *et al*. (2011) found that only 22 plant species registered during 2002/2003 but after 4 years of protection the plant species numbers were increased.

Using remotely sensed biophysical variable in the further studies in the future is a crucial method to predict the species richness at regional spatial scales for monitoring species diversity and distribution (John *et al*., 2008). Study the natural wild fields can lead to improvement them and optimal use. Strategically planning is needed for management, monitoring and conservation of biodiversity. Effective action plan is demand for the conservation of biodiversity in Jordan in order to restore degraded wildlife ecosystems and to regulate and improve the socio-economic practices affecting wildlife.

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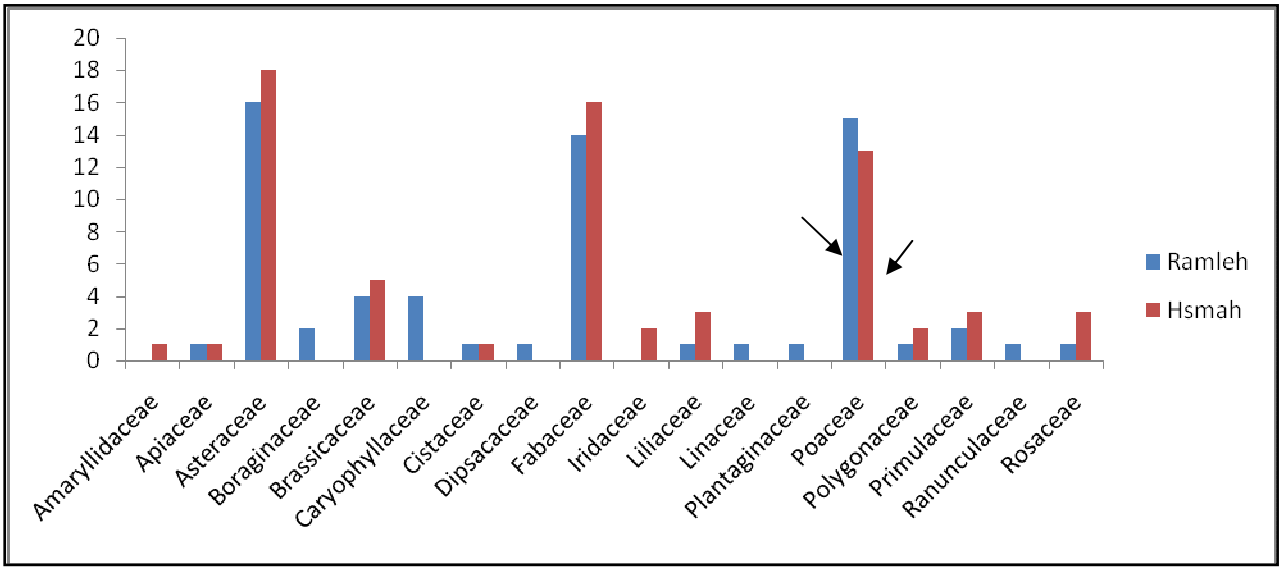

Figure 1: Families frequencies over three years 2009-2012 at Wadishueib (Ramleh and Hsmah) at Jordan. The left row indicated Hsmah and the right row refers to Ramleh.

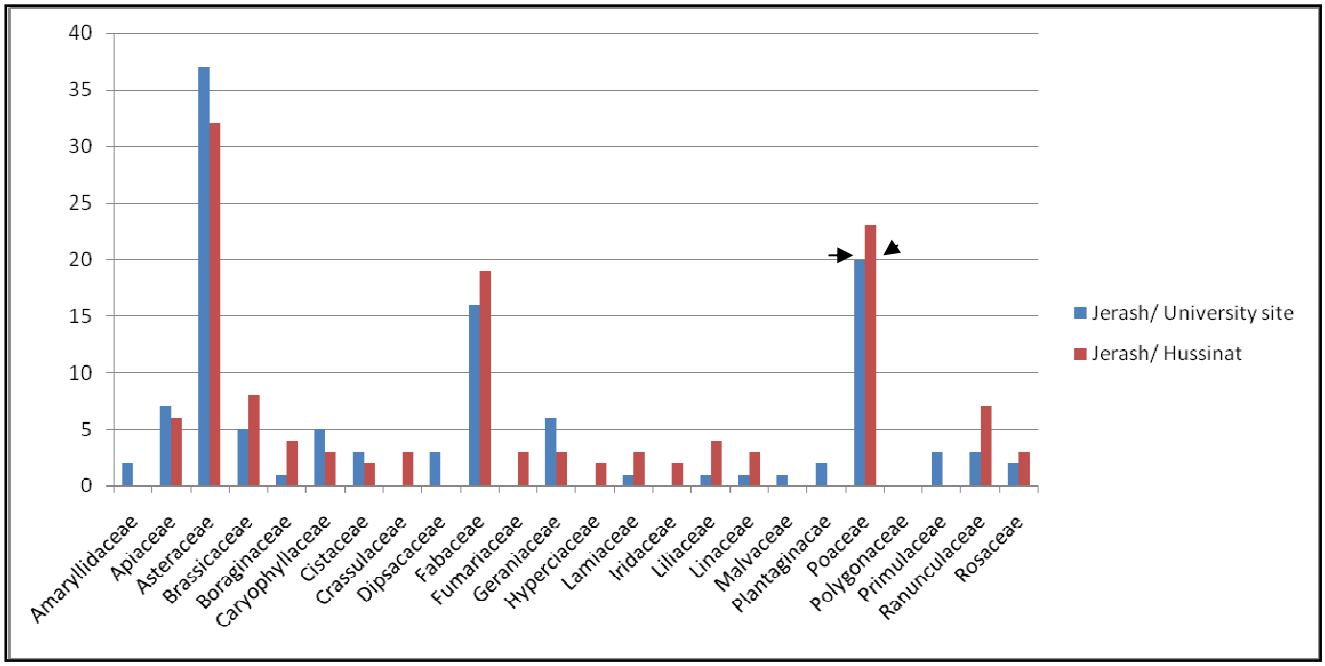

Figure 2: Families frequencies over three years 2009-2012 in Jerash study area at Jordan. The left row indicated Hussinat and the right row refers to University site.

Table 3: The density and frequency of *Paronychia argentea* at Ramleh region of wadishueib in Jordan.

Species	2009/2010		Species	2010/2011		Species	2011/201	
	Density	Frequency		Density	Frequency		Density	Frequency
Agelopis peregrina	3.2	0.20	*Agelopis peregrina*	0.200	0.07	*Agelopis peregrina*	0.667	0.07
Agelopis vavilovii	0.267	0.07	*Anchusa sp.*	0.133	0.07	*Anagalis arvensis*	1.2	0.40
Anagallis arvensis	0.200	0.13	*Anthemis palaestina*	1.067	0.33	*Allium* sp.	0.800	0.27
Anthemis palaestina	2.933	0.47	*Astragulus* sp.	0.067	0.07	*Anchusa* sp.	0.133	0.07
Bromus fasciculatus	0.333	0.33	*Calendula arvensis*	0.133	0.07	*Anthemis palaestina*	1.867	0.400
Carthamus sp.	0.667	0.47	*Centurea apic*	1.867	0.33	*Astragulus* sp.	0.067	0.07
Centurea apic	0.400	0.13	*Cynodon dactylon*	0.333	0.07	*Centurea apic*	1.867	0.33
Hordeum glaucum	3.00	0.33	*Bromus fasciculatus*	0.467	0.27	*Cynodon dactylon*	0.333	0.07
Medicgo orbicularis	0.333	0.13	*Filago pyramidata*	0.133	0.07	*Crepis* sp.	0.667	0.13
Medicago radiata	0.133	0.13	*Hordeum glaucum*	1.133	0.33	*Bromus fasciculatus*	0.667	0.27
Ononis natrix	0.067	0.07	*Linum pubescens*	0.533	0.20	*Filago pyramidata*	0.867	0.27
Paronychia argentea	1.200	0.53	*Medicago* sp.	1.467	0.33	*Helianthemum* sp.	0.133	0.07
Picris altisima	1.133	0.60	*Paronychia argentea*	1.867	0.67	*Hordeum glaucum*	8.067	0.40
Poa bulbosa	0.267	0.27	*Pecris* sp.	0.533	0.13	*Lathyrus* sp.	0.067	0.07
Rumex sp.	0.867	0.20	*Senecio vernalis*	0.867	0.27	*Gundelia tournefortii*	0.067	0.07
Sinapis alba	0.867	0.53	*Sinapis alba*	0.133	0.07	*Linum pubescens*	0.333	0.13
Trifolium campestre	0.400	0.20	*Trifolium campestre*	0.800	0.27	*Medicago* sp.	0.933	0.27
Continue for Ramleh								
Species	2011/2012		Species	2011/2012		Species	2011/2012	
	Density	Frequency		Density	Frequency		Density	Frequency
Medicago radiata	0.267	0.27	*Ranunculus asiaticus*	0.067	0.07	*Sinapis alba*	0.067	0.07
Ononis sp.	0.133	0.13	*Raphanus rostratus*	0.333	0.27	*Trifolium campestre*	0.067	0.07
Paronychia argentea	3.20	0.67	*Scabiosa* sp.	0.533	0.27	*Trifolium stellatum*	0.067	0.07
Pecris sp.	0.400	0.13	*Sarcopoterium spinosum*	0.067	0.07	*Torilis tenella*	0.067	0.07
Plantago sp.	0.067	0.07	*Senecio vernalis*	1.333	0.400	--	--	--
Poa bulbosa	3.00	0.47	*Silene* sp.	0.467	0.13	--	--	--

Table 4: The density and frequency of *Paronychia argentea* species within Hsmah region at wadishueib in Jordan.

Species	2009/2010		Species	2010/2011		Species	2011/2012	
	Density	Frequency		Density	Frequency		Density	Frequency
Agelopis vavilovii	0.333	0.067	*Allium* sp.	0.600	0.200	*Anagallis arvensis*	0.133	0.133
Agelopis peregrina	0.667	0.067	*Anagallis arvensis*	0.467	0.267	*Anthemis palaestina*	1.800	0.200
Anagalis arvensis	1.267	0.400	*Anthemis palaestina*	0.600	0.267	*Asphodeline* sp.	1.333	0.267
Allium sp.	0.800	0.267	*Asphodeline* sp.	0.133	0.133	*Bromus fasciculatus*	0.200	0.200
Anthemis palaestina	0.333	0.267	*Biscutella didyma*	0.067	0.067	*Carthamus glaucus*	0.200	0.200
Calendula arvensis	0.067	0.067	*Centurea* sp.	0.067	0.067	*Calendula arvensis*	0.133	0.067
Centurea apic	0.067	0.067	*Crepis* sp.	0.267	0.200	*Crataegus aronia*	0.133	0.067
Bromus fasciculatus	0.333	0.200	*Cynodon dactylon*	0.067	0.133	*Filago* sp.	0.600	0.200
Filago pyramidata	0.400	0.333	*Coronilla* sp.	0.067	0.067	*Hordeum glaucum*	0.067	0.333
Helianthemum sp.	0.133	0.067	*Filago pyramidata*	0.600	0.133	*Filago pyramidata*	0.067	0.067
Hordeum glaucum	0.067	0.067	*Hordeum glaucum*	0.267	0.133	*Irsis* sp.	0.067	0.067
Lathyrus sp.	0.067	0.067	*Irsis* sp.	0.067	0.267	*Medicgo orbicularis*	0.267	0.133
Medicago sp.	0.067	0.067	*Medicgo orbicularis*	0.267	0.067	*Medicago radiata*	0.133	0.133
Medicago radiata	0.267	0.267	*Medicago radiata*	0.133	0.800	*Lolium rigidum*	0.200	0.067
Paronychia argentea	3.267	0.867	*Lotus* sp.	1.133	0.333	*Lotus* sp.	1.40	0.467
Pecris sp.	0.333	0.333	*Ononis natrix*	0.067	0.067	*Ononis natrix*	0.067	0.067
Plantago sp.	0.467	0.067	*Paronychia argentea*	2.867	0.267	*Paronychia argentea*	9.667	0.867
Poa bulbosa	3.00	0.467	*Pecris altisima*	0.800	0.067	*Pecris altisima*	0.800	0.333
Raphanus rostratus	0.333	0.267	*Plantago* sp.	0.133	0.267	*Poa bulbosa*	0.800	0.133
Scabiosa sp.	0.533	0.267	*Poa bulbosa*	1.00	0.067	*Rumex* sp.	0.067	0.067
Silene sp.	0.467	0.133	*Rumex* sp.	0.067	0.067	*Sarcopoterium spinosum*	0.067	0.067
Sinapis alba	0.067	0.067	*Sarcopoterium spinosum*	0.067	0.067	*Senecio glaucus*	0.600	0.267
Trifolium campestre	0.533	0.200	*Senecio glaucus*	0.467	0.267	*Sinapis alba*	0.867	0.533
Trifolium stellatum	0.067	0.067	*Sinapis alba*	0.867	0.533	*Trifolium campestre*	0.667	0.333
Torilis tenella	0.067	0.067	*Trifolium campestre*	0.667	0.200	---	----	--

Table 6: The density and frequency of Paronychia argentea Jeash governorate / Hussiant region in Jordan.

Species	Density 2009/2010	Frequency 2009/2010	Species	Density 2010/2011	Frequency 2010/2011	Species	Density 2011/2012	Frequency 2011/2012
Achillea bibersteinii	0.677	0.067	*Achillea bibersteinii*	0.800	0.067	*Achillea bibersteinii*	3.00	0.133
Achillea santolinea	5.333	0.067	*Achillea santolinea*	5.33	0.067	*Achillea santolinea*	5.467	0.133
Aegilops peregrina	0.733	0.133	*Aegilops peregrina*	0.600	0.133	*Aegilops peregrina*	6.00	0.267
Adonis microcarpa	0.133	0.067	*Adonis microcarpa*	0.067	0.067	*Adonis microcarpa*	0.067	0.067
Anchusa aegyptiaca	0.133	0.067	*Allium* sp.	0.067	0.067	*Allium* sp.	0/067	0.067
Anthemis palaestina	9.867	0.600	*Alyssum damascenum*	0.200	0.133	*Alyssum damascenum*	0.067	0.067
Avena barbata	1.467	0.400	*Anemon* sp.	1.133	0.200	*Anemon* sp.	1.133	0.267
Astragalus tribuloides	0.267	0.067	*Anchusa aegyptiaca*	0.067	0.067	*Anchusa aegyptiaca*	0.067	0.067
Biscutella didyma	0.067	0.067	*Anthemis palaestina*	1.600	0.333	*Anchusa strigosa*	0.133	0.133
Bromus fasciculatus	4.533	0.600	*Avena barbata*	0.400	0.200	*Anthemis palaestina*	6.333	0.600
Centaurea iberica	0.067	0.067	*Astragalus tribuloides*	0.267	0.067	*Avena barbata*	0.400	0.200
Crataegus aronia	0.067	0.067	*Biscutella didyma*	0.600	0.400	*Avena sterilis*	2.267	0.600
Daucus aureus	0.200	0.067	*Bromus fasciculatus*	4.933	0.600	*Astragalus tribuloides*	0.267	0.067
Echinops sp.	0.200	0.133	*Centaurea iberica*	0.133	0.133	*Biscutella didyma*	0.067	0.067
Erodium moschatum	0.067	0.067	*Crataegus aronia*	0.067	0.067	*Bromus fasciculatus*	3.467	0.467
Fumaria asepala	0.133	0.067	*Crocus* sp.	0.200	0.067	*Bromus rubens*	7.267	0.333
Hordeum glaucum	0.133	0.067	*Daucus aureus*	0.200	0.067	*Centaurea iberica*	0.133	0.133
Hordeum bolbosum	0.067	0.067	*Echinops sp.*	0.333	0.267	*Crataegus aronia*	0.067	0.067
Linum pubescens	0.067	0.067	*Erodium moschatum*	2.533	0.600	*Crepis* sp.	0.067	0.067
Lolium rigidum	0.467	0.2	*Filago* sp.	0.067	0.067	*Crocus* sp.	0.200	0.067

Notobasis syriaca	0.067	0.067	*Fumaria asepala*	0.133	0.067	*Daucus aureus*	0.200	0.067
Ononis natrix	1.133	0.667	*Helianthemum*	0.333	0.067	*Echinops* sp.	0.267	0.267
Paronychia argentea	0.400	0.333	*Hordeum glaucum*	0.133	0.067	*Erodium moschatum*	0.133	0.067
Poa bulbosa	3.333	0.467	*Hordeum bolbosum*	0.067	0.067	*Filago* sp.	0.067	0.067
Rhagadiolus stellatus	0.133	0.067	*Hypericum triquetrifolium*	0.333	0.133	*Fumaria asepala*	0.133	0.067
Sedum sediforme (=nicaeense)	0.067	0.067	*Lathyrus blepharicarpus*	0.067	0.067	*Helianthemum* sp.	0.333	0.067
Sinapis alba	0.067	0.067	*Lathyrus* sp.	1.400	0.267	*Hordeum glaucum*	0.133	0.067
Teucrium capitatum	0.067	0.067	*Linum pubescens*	0.067	0.067	*Hordeum bolbosum*	9.800	0.200
Trifolium campestre	0.200	0.067	*Lolium rigidum*	0.467	0.200	*Hypericum triquetrifolium*	0.067	0.067
Trifolium scutatum	0.200	0.067	*Notobasis syriaca*	0.067	0.067	*Lathyrus blepharicarpus*	0.133	0.067
Torilis nodosa	0.133	0.067	*Ononis natrix*	0.400	0.333	*Lathyrus* sp.	1.400	0.267
Vicia cypris	0.067	0.067	*Paronychia argentea*	0.400	0.333	*Linum pubescens*	0.067	0.067
---	---	---	*Pecris* sp.	2.333	0.600	*Lolium rigidum*	0.467	0.200
---	---	---	*Poa bulbosa*	3.133	0.467	*Notobasis syriaca*	0.067	0.067
---	---	---	*Ranunculus millefolius*	0.733	0.400	*Ononis natrix*	0.867	0.600
---	---	---	*Rhagadiolus stellatus*	0.133	0.067	*Paronychia argentea*	0.400	0.333
---	---	---	*Sedum sediforme (=nicaeense)*	0.067	0.067	*Pecris sp.*	2.333	0.600
---	---	---	*Senecio glaucus*	0.133	0.067	*Poa bulbosa*	4.733	0.067
---	---	---	*Silybum marianum*	0.067	0.067	Ranunculus millefolius	0.600	0.267
---	---	---	*Sinapis alba*	0.067	0.067	*Rhagadiolus stellatus*	0.133	0.133
---	---	---	*Teucrium capitatum*	0.067	0.067	*Sedum sediforme (=nicaeense)*	0.133	0.133
---	---	---	*Trifolium*	0.533	0.267	*Senecio glaucus*	0.267	0.067

			campestre					
---	---	---	*Trifolium scutatum*	0.200	0.067	*Silybum marianum*	0.133	0.067
---	---	---	*Torilis nodosa*	0.133	0.067	*Sinapis alba*	0.067	0.067
---	---	---	*Tulipa agenensis*	0.200	0.067	*Teucrium capitatum*	0.067	0.067
---	---	---	*Vartamia* sp.	0.133	0.067	*Trifolium campestre*	0.200	0.067
---	---	---	*Vicia cypris*	0.200	0.133	*Trifolium scutatum*	0.200	0.067
---	---	---	---	---	---	*Torilis nodosa*	0.133	0.067
---	---	---	---	---	---	*Tulipa agenensis*	0.200	0.067
---	---	---	---	---	---	*Vartamia* sp.	0.133	0.067
---	---	---	---	---	---	*Vicia cypris*	0.200	0.133