FLORISTIC COMPOSITION OF ROADSIDES IN WESTERN SAUDI ARABIA

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Abstract. Roadsides are home to a diverse range of species with varying geographic origins. The aim of the current study is to describe the floristic diversity of roadside vegetation in western Saudi Arabia, as well as to examine the impact of altitude on this diversity. Roadsides were divided into belts according to their elevations above sea level. The floristic composition, the exotic aliens, weeds, life forms, and the chorology of each belt were determined. The study showed that the amount of rain, temperature, heavy traffic, and altitude have a major role in the distribution of these plants. The total species recorded on both roadsides was 228 species, where the difference between the two roads was not only in species number but also in the floristic composition. In the current study, two endemic species, *Kickxia pseudoscoparia* and *Euphorbia ammak,* were recorded. The most frequent species overall was *Forsskaolea tenacissima*, which was found in all studied belts, followed by *Aerva javanica*, which was found in 87% of the studied belts. The therophytes dominated the other life forms by 44.8%, followed by chamerophytes which exhibited about 26.5%. Primarily, this study will improve the understanding of the distribution of plants on roadsides in the study area and help to manage alien and invasive species.
Keywords: *chorotype, arid lands, life forms, flora, weeds, exotic species*

Introduction

Roadsides are disturbed places that often support ruderal plants (Zamani et al., 2020); their floristic composition varies depending on environmental conditions and anthropogenic activity. The floristic composition of roadside vegetation is influenced by various environmental factors, including topography, climate, soil properties of the habitats along the road, and vegetation type of the surrounding areas (Akbar et al., 2009; Lembrechts et al., 2014). New artificial habitats are created along roadways when they are built in natural regions. These habitats sustain species with different requirements for habitat, and they are distinct from the nearby natural regions (Irl et al., 2014). Roadsides are home to a diverse range of species with varying geographic origins (Holzapfel and Schmidt, 1990). Previously, it was reported that the flora along roadsides is composed of both native and non-native species with varying local, zonal, and global distributions (Akbar et al., 2009). In roadside habitats, some human and environmental factors contribute to a distinct floristic composition; yet it can be challenging to isolate the relative contributions of these factors. The primary human factors influencing roadside vegetation are road characteristics and their upkeep practices (Azcárate et al., 2013).

Roadsides can serve as pathways for alien plant species to disperse as well as habitats for both native and non-native plant species (Okimura et al., 2016). In addition, roadside habitats can be impacted by alien plant invasion and species extinction in far-off

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ecosystems, as the effects of roadways can reach great distances (Liedtke et al., 2020). By displacing or eradicating native species, development practices also increase the disturbed regions along roadside edges and encourage the invasion of alien species (Liedtke et al., 2020). Enríquez-de-Salamanca and Álvaro (2022) concluded that the unaltered natural regions are inhospitable to several non-native species that thrive in roadside settings. Nonetheless, certain alien species have the potential to proliferate in natural settings, pose a threat to the biodiversity of these areas by competing with local flora (Szymura and Szymura, 2016). Species of roadside habitat include common farmland and rangeland weeds, as well as plant species found in near natural regions. Non-native species are ubiquitous, similar to pluri-regional and cosmopolitan species, and typically have a multi-regional origin. According to their ecological characteristics and geographic distribution, plant species react differently to changes in the global environment (Broennimann et al., 2006). Therefore, data from phytogeographical studies of roadside vegetation in various locations and elevations may be used to anticipate how different species would react to changes in climate. Thus, building and maintaining highways is thought to be crucial for the political, economic and social growth of any nation (Ahmad et al., 2004). Understanding roadside flora globally is essential for managing alien and invasive species since species disperse at various sizes (Shaltout et al., 2016). The current study aimed to determine the floristic diversity of roadside vegetation in western Saudi Arabia, as well as the impact of altitude on this diversity.

Materials and methods

Study area

Two different roads were chosen in the west of the Kingdom of Saudi Arabia. The first road (M) links Makkah city with Madina city, and the second one links Makka city with Taief city (T) (*Figure 1*). The first road runs through natural vegetation, sandy and rocky lands as well as through volcanic rocks. The second road (T) is called Al-Hada Road, linking Makkah and the city of Taif, a road above Sarawat Heights, a steep, spiral road. The climatic data for the two roads showed that the precipitation in T road is higher than those in M road and in contrast the average temperature in M road is higher than those in T road (*Table 1*).

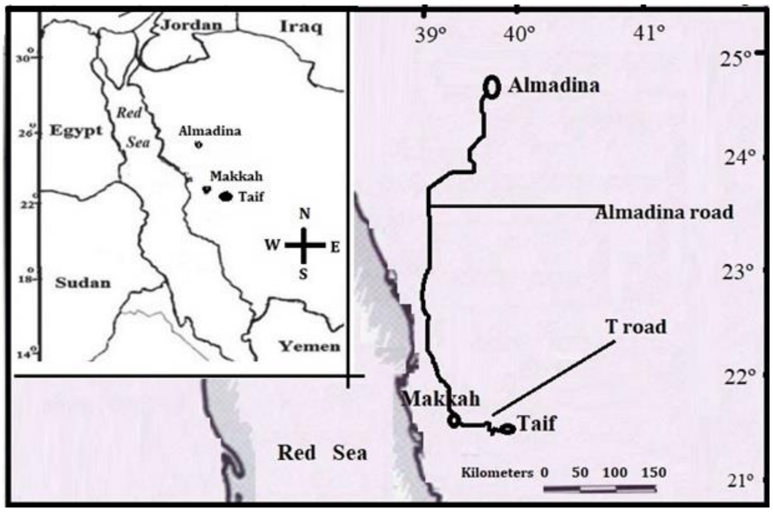

Figure 1. *Location map showing the two studied roads*

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Table 1. *Monthly variations of rainfall and temperature and their annual means in the study area. The data were extracted from the (Taif meteorological station, Saudi Arabia)*

	Avg. Temperature °C		**Precipitation (mm)**		**Rainy days (d)**	
	M-road	**T-road**	**M-road**	**T-road**	**M-road**	**T-road**
January	23	15.1	25	37	2	4
February	23.9	17.1	2	10	1	2
March	25.2	19.3	4	22	1	4
April	27.6	22.1	4	37	0	6
May	30	25.8	0	26	0	4
June	30.9	28.2	0	2	0	1
July	32	27.5	0	3	0	1
August	32.1	27.4	0	16	0	3
September	31.1	26.7	0	14	0	3
October	29.6	22.9	3	10	0	2
November	27.1	18.8	26	15	2	3
December	24.7	16.2	15	20	2	3

Sample collection

The plant samples were collected following the guidelines and legislation of both the Environmental Affairs Agency and the Wildlife Authority in Saudi Arabia. The survey was done in the period from March 2022 and April 2023. *Appendix 1* shows the GPS positions of the surveyed sites. Each road was divided into different elevational belts, and the sampling stands in each belt were determined randomly as homogeneous physiographic-physiognomic units (Kent and Coker, 1992) along the different roads (at distances from one to ten meters from the road edge). Each physiographic-physiognomic unit was representative of a given topography, soil, and vegetation type. Thirty-eight stands were selected and considering the topography and road shape at each stand, two to five rectangular quadrats (100 m^2) were established on both sides of the road. The width of the survey ranged between 10 and 30 meters, while the length ranged between 50 and 100 meters. The average traffic on both roads was equal, medium traffic. In each quadrat, a list of vascular plants was made, and herbarium specimens were collected for exact identification. Plant samples were collected according to Chaudhary (2001). The life forms of the collected species were determined by the location of the regenerative buds and the portions lost during the unfavorable season (Raunkiaer, 1934). The biogeographic affinities of the species were determined according to Zohary (1973).

Statistical analyses

Using Wards' (minimum variance) approach and Euclidean distances as a dissimilarity metric, a hierarchical classification technique based on presence/absence data was used to evaluate the floral similarities between different elevation belts (Ward, 1963). The Statistica statistical software package, version 8 (StatSof, Inc., Tulsa, OK, USA), was used for the analysis. ß-diversity/similarity among belts was assessed using the Jaccard similarity index, which was calculated using the following formula: Jaccard Index= (the number in both sites)/ (the number in either site) * 10) (Castro and Jaksic, 2008).

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Results

Floristic composition and their distribution

In general, the total species recorded on both roadsides were 228 species, of which 177 were found on T road and 85 on M road (*Appendix 2*), while the total number of common species on the two roadways was 34. The difference between the two roads was not only in species number but also in the floristic composition. More than 82% of the recorded species on T road were absent on M road, while in contrast, 61.1% of the recorded species on M road were absent on T road (*Appendix 2*). The ward classification yielded two primary groups; each group represented the elevation belts for single road (*Figure 2*).

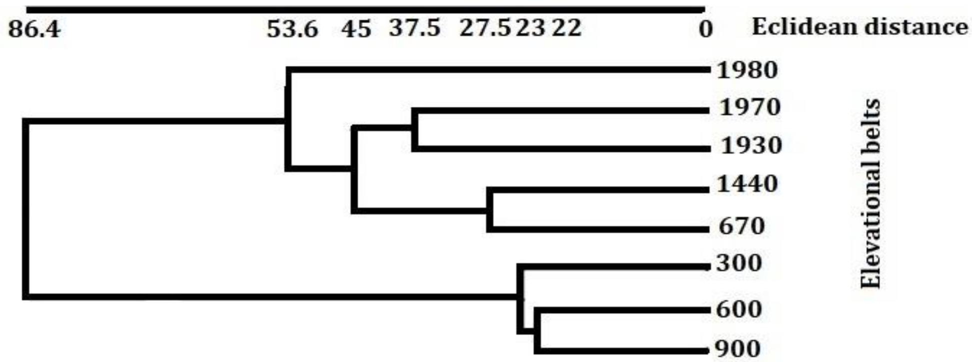

Figure 2. *Hierarchical classification of the elevational belts of the studied roads based on their floristic composition (incidence data), obtained using Ward's method and Euclidean distances as measures of Linkage Distance*

The elevation of the belt determined the second division, which was based on the elevation of each belt for each group. The Jaccard similarity confirmed the result of ward classification, where the higher indices were obtained between sites with the closest elevation on the same road (*Table 2*). In addition, Jaccard similarities among belts on M Road were higher than those obtained among T Road belts. The highest similarity index was obtained between the two sites at M Road, 300 and 600 m.a.s.l (*Table 2*).

Table 2. *JACCARD similarities between different elevation belts for the both roads, T: Taief road and M: Madina road*

Elevation/ Road	1980 T	1970 T	1930 T	1440 T	670 T	300 M	600 M	900 M
1980 T	1.00	1						
1970 T	0.25	1.00	1					
1930 T	0.28	0.28	1.00	1				
1440 T	0.21	0.14	0.19	1.00	1			
670 T	0.09	0.08	0.11	0.11	1.00	1		
300 M	0.10	0.04	0.08	0.15	0.07	1.00	1	
600 M	0.12	0.10	0.09	0.08	0.08	0.43	1.00	1
900 M	0.08	0.07	0.06	0.09	0.06	0.33	0.41	1.00

The most frequent species overall was *Forsskaolea tenacissima*, which was found throughout all studied belts, followed by *Aerva javanica* which was found throughout 100% and 87% of the studied belts on M road and T road, respectively (*Table 3*). Some

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species were recorded in all sites of M Road and absent in T Road *such* as *Zygophyllum simplex*, *Senna italica, Euphorbia granulate, Asphodelus tenuifolius, Aristida mutabilis* and *Dipterygium glaucum*; in contrast, *Fagonia indica* and *Lavandula coronopifolia* were recorded in all belts of T Road and absent in M Road. Ten exotic species were recorded on the studied roadsides: nine species on T road and only one species on M road (*Figure 3*). *Argemone ochroleuca* was the most frequent species on T Road, followed by *Heliotropium curassavicum* and *Amaranthus spinosus*. Weed species ranged between 8.5% and 36.2% in T road and between 10% and 16.4% in M road (*Figure 3*), where *Cynodon dactylon* and Cenchrus ciliaris were the most frequent species, while *Chenopodium murale* and Malva parviflora recorded the highest frequencies in M road.

Table 3. *The most frequent species recorded on the studied roads*

Families	Species	Frequencies		Life form	Chorotype
		M-M	T		
Aizoaceae	*Aizoon canariense* L.	0.65	0	Th	Sa-Si+S-Z
Amaranthaceae	*Aerva javanica* (Burm.f.) Juss. ex Shult.	1	0.87	Ch	Sa-Si+S-Z
Chenopodiaceae	*Salsola imbricata* Forssk.	0	0.80	Ch	Sa-Si+S-Z
Compositeae	*Osteospermum vaillantii* (Decne.) Norl.	0	0.80	Th	Sa-Si+S-Z
Cruciferae	*Dipterygium glaucum* Decne.	0.6	0	Ch	SU
Cucurbitaceae	*Citrullus colocynthis* (L.)Schrad	0.3	0	He	SA
Euphorbiaceae	*Euphorbia granulata* Forssk.	0.36	0	Th	S-Z
Gramineae	*Sisymbrium irio* L.	0.035	0	Th	Med +I-T + Sa-Si
Gramineae	*Aristida mutabilis* Trin. & Rupr.	0.63	0	Th	Palaeo
Gramineae	*Cynodon dactylon* (L.) Pers.	0.34	0.8	Ge	Sa-Si+S-Z+I-T
Gramineae	*Astragalus vogelii* (Webb)Bornm.	0.3	0	Th	SA
Gramineae	*Cenchrus ciliaris*	0	0.8	He	Palaeo
Labiatae	*Lavandula a dentata* L.	0	0.95	Ch	Sa-Si+S-Z+I-T
Leguminoseae	*Senna italica* Mill.	0.42	0	He	SU
Malvaceae	*Abutilon pannosum* (Forst.f.)Schltdl.	0.38	0	Ch	TR
Moraceae	*Ficus palmata* subsp. *virgata* Browicz	0	0.7	Ph	Sa-Si+S-Z
Nyctaginaceae	*Commicarpos plumbagineus*	0	0.8	He	Sa-Si+S-Z+M
Resedaceae	*Ochradenus baccatus* Delile	0	0.8	Ph	Sa-Si+S-Z
Solanaceae	*Solanum incanum* L.	0.75	0	Ch	Sa-Si
Urticaceae	Forsskalea tenacissima L.	1	1	He	SA+SU
Zygophyllaceae	Fagonia indica Burm.f.	0.41	0.95	He	Sa-Si+I-T
Zygophyllaceae	Zygophyllum simplex L.	1	0	Th	Sa

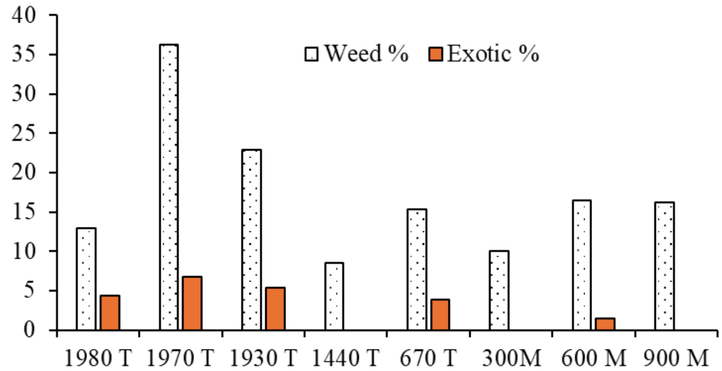

Figure 3. *Distribution of the weeds and exotic species recorded in the different elevational belts of the studied roads*

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Life forms

Five life forms were recorded in the studied road habitats: therophytes, chamerophytes, phanerophytes, hemicryptophytes and geophytes. Generally, the therophytes dominated the others by 44.8% and 41.2%, followed by chamerophytes which exhibited 22.9% and 26.5% of the recorded life forms in M road and T road, respectively (*Figure 4*). *Figure 4* shows that phanerophytes recorded 8.1% and 12.9%, while geophytes recorded the lowest ratio with 2.3% and 7.3% in M road and T road, respectively. There is no clear behavior when the elevation increases or decreases for the life form of the plants on the two roads, unless the phanerophytes recorded an increase with the increase in elevation on the T Road, and in contrast, they recorded a decrease with the increase in elevation on the M Road (*Table 4*).

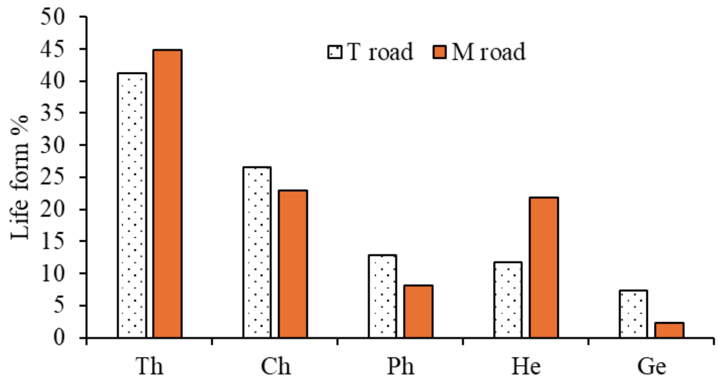

Figure 4. *Percentage of the life forms recorded on the studied roads. Ph, phanerophytes; Ch, chamaephytes; Ge, geophytes; He, hemi-cryptophytes and Th, therophytes*

Table 4. *Life forms (%) recorded in the different elevational belts of the studied roads. Ph, phanerophytes; Ch, chamaephytes; Ge, geophytes; He, hemi-cryptophytes and Th, therophytes*

	Elevational belts (m.a.s.l.)							
	T road					**M road**		
	670	**1440**	**1930**	**1970**	**1980**	**300**	**600**	**900**
Th	0.35	0.18	0.38	0.53	0.35	0.33	0.52	0.41
Ch	0.39	0.39	0.25	0.12	0.31	0.27	0.19	0.28
Ph	0.07	0.18	0.16	0.08	0.18	0.12	0.07	0.05
He	0.1	0.11	0.1	0.13	0.11	0.27	0.2	0.23
Ge	0.07	0.11	0.09	0.12	0.03	0.02	0.01	0.03

Chorological affinities

Figure 5 displays the chorological investigation of the sampled flora of the two roads. The bioregional elements dominate the studied roadsides by 26.2% and 37.7% on M road and T road, respectively, while the monoregional elements, Saharo-Sindian elements, are represented by 8% and 11.2%, respectively (*Figure 5*). The Mediterranean elements were counted at 6.8% and 3.3% on M road and T road, respectively, while cosmopolitan elements exhibited 5.7% and 7.9% in M road and T road, respectively. In the current study, two endemic species, *Kickxia pseudoscoparia* and *Euphorbia ammak*, were recorded in T roadside (*Appendix*). Elevation showed an effect on the distribution of some

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chorotypes, where the bioregional elements Saharo Arabian-Saharo-Sindian/Sudano-Zambezian decreased with the elevation increase (*Table 5*). In contrast, the Mediterranean elements exhibited an increase with increasing elevation.

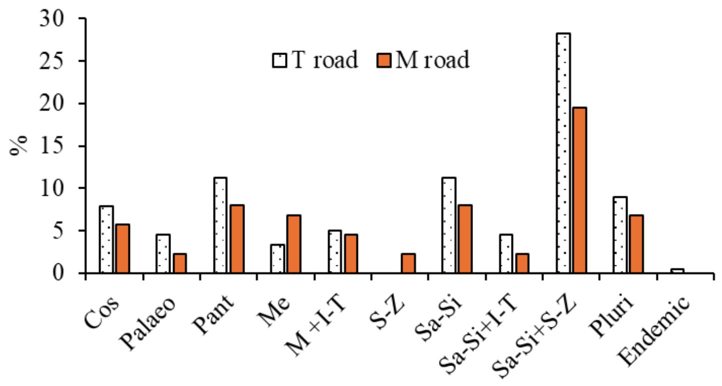

***Figure 5.** Percentage of most chorotype recorded on the two studied roads*

***Table 5.** Chorotype percentage recorded in the different elevational belts of the studied roads*

	Elevational belts (m.a.s.l.)							
	T road					M road		
	670	1440	1930	1970	1980	300	600	900
Cos	0.11	0.02	0.08	0.12	0.06	0	0.07	0.08
Palaeo	0.11	0.09	0.04	0.03	0.05	0.04	0.01	0.05
Pant	0.11	0.02	0.13	0.09	0.06	0.08	0.07	0
Me	0	0	0.04	0.02	0.04	0.02	0.09	0.05
M +I-T	0	0	0	0.09	0.06	0.06	0.03	0.03
S-Z	0.07	0	0	0	0	0.17	0.01	0.05
Sa-Si	0.04	0.12	0.07	0.12	0.13	0.02	0.01	0.05
Sa-Si+I-T	0.07	0.05	0.05	0.03	0.06	0	0.03	0.03
Sa-Si+S-Z	0.46	0.44	0.31	0.16	0.31	0.25	0.22	0.21
Pluri	0.11	0.14	0.13	0	0.09	0.04	0.07	0.1
Endemic	0	0.02	0	0	0.02	0	0	0

Discussion

Roadsides comprise varied environmental conditions that help in supporting the habitat and the conservation of species for maintaining nature's value (Wilson et al., 1992), explaining the higher species number, 228 species, recorded in the current study. Although the study area is an arid area characterized by xerophytic (Alsherif et al., 2013) the results recorded an aquatic plant, *Lemna gibba*. Water availability from road surface run-off has positive effects on plants growing along roadsides, particularly in arid and semi-arid regions, which explains the higher species number in T road than those recorded in M road.

The difference in composition of total plant species observed along the two different roads may be accounted for by many factors including temperature and rainfall. The floristic composition on T road differed most significantly from those of the M road because of the amount of rainfall is higher in T road than in M road and there was no additional manmade clearance on the roadsides. Species distribution on roadsides in the

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current study varies along different altitude and agree with many previous studies (Alsherif and Fadl, 2016; Noroozi et al., 2016; Fadl et al., 2021). Many climatic variables such as temperature, moisture, and precipitation vary concurrently with elevation (Alexander et al., 2009), thereby affecting plant distribution at different altitudes. On M road the mid altitude exhibited the highest species number, while on T road the highest species number was recorded in the highest altitude. Many researchers have described maximum species richness in the lower third of the elevational gradient (Alexander et al., 2016). In arid and semiarid climates, the low to mid-altitude roadsides provide superior moisture for plant growth, thus increasing the occurrence of endemic taxa. Mid-altitudes are more susceptible to invasion of alien species compared to low and high elevations (Marini et al., 2012). Arévalo et al. (2005) reported that the intensity of disturbances at mid-altitudes promotes the dispersal of alien plants, explaining the current results where mid-altitude in M road exhibited the highest number of weeds.

Many exotic species were recorded in our results due to that roads are a logical focus for a landscape-level examination of invasion, because they are the entry points for many or most human influences that affect the invasion process. The high number of exotic species have been observed near roadsides in many ecosystems (Tyser and Worley, 1992). Such patterns partly reflect the disturbed condition of roadsides themselves, but also suggest that roads act as sources of exotic propagules (Lonsdale and Lane, 1994) and as conduits for human disturbances that promote invasion (Greenberg et al., 1997). The elevation belt 1970 on T road included the highest weed and exotic species number because this belt is a circular road surrounding Taief city with heavy traffic and collect transfer alien species propagules along roads (Kalwij et al., 2008). Previous studies reported that the colonization and eventual dominance of roadsides by disturbance-adapted alien species, bringing reproductive plants into close proximity with natural habitats (Kalwij et al., 2008). It is therefore reasonable to expect the occurrence of alien flora in natural habitats to be correlated with adjacent roadside corridors (Tyser, 1999).

Although flora of Saudi Arabia includes low number of endemic species (Al-Nafie, 2008), two endemic species were recorded in the current results. Previously, it was reported that the roadsides are susceptible to species invasion, they can support various native species and act as a refuge for some plants (Turner et al., 2021; Bernardos et al., 2023; Bénard et al., 2024). In addition, roads may promote endemic species dispersal and increase species turnover of these habitats (Irl et al., 2014).

Numerous studies have revealed close positive relation between intensity of disturbance and weed invasibility (Renne and Tracy, 2013; Houseman et al., 2014), while negative relations were observed between abundance of native species and weed invisibility (Greene and Blossey, 2012; Bernard-Verdier and Hulme, 2015). Transportation of agricultural products locally is the main reason for seed dispersal of weed species along the roadsides. The transported seeds can germinate and thrive in the roadside habitats, threatening the biodiversity of the surrounding natural areas (Houseman et al., 2014).

According to Raunkiaer (1934), the main climatic patterns are dictated by the fact that one or a small number of life forms dominate either greatly or completely. Therophyte, a life form with traits of an arid desert environment, was the most often seen life type in the current study. The variety of life forms found in this study is characteristic of an arid desert region, which lends credence to Deschenes's (1969) idea that therophytes arise because of the dry climate. It's possible that topographic variations or dryness contributed

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to therophytes' dominance, followed by chamaephytes, in this study's life-form analysis (El-Bana et al., 2002).

The lower proportion of geophytes due to it have a lower adaptability to drought conditions than other living forms, which could have influenced our results on geophyte abundance. The chorotypes of the species that have been seen match those from earlier studies conducted in the Khulais region (Al-Sherif et al., 2013), in the Asir Mountains of Saudi Arabia (Al-Sherif and Fadl, 2016), and in the Hail area by Al-Turki and Al-Olayan (2003).

According to numerous early studies, the Saharo-Arabian-Sindian region and the Sudano-Zambezian region-two major phytogeographical regions that encompass most of North Africa and the Middle East-make up the flora and vegetation of Saudi Arabia (Zohary, 1973; White and Leonard, 1991). While White and Leonard (1991) contend that the Sudano-Zambezian region encompasses both western and southern Arabia, Wickens (1976) indicated that the Saharo-Sindian factor is the primary impact on the investigated area. These influences provide an explanation for why the Saharo-Sindian elements had the greatest values for monoregional, biregional, and pluriegional species, followed by the Sudano-Zambesian elements.

Conclusion

Road construction creates local microhabitats varying in floristic composition. Alien and weed species invade these habitats. Precipitation, temperature, altitude, and traffic level are factors determining plant diversity on roadsides. Primarily, this study will improve the understanding of the distribution of plants on roadsides in the study area and help to manage alien and invasive species.

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APPENDIX

Appendix 1. *GPS positions of the surveyed sites*

Elevation/ Road	Latitude	Longitude
1980 T	21°21'8.23"N	40°18'42.46"E
1970 T	21°21'39.05"N	40°16'18.27"E
1930 T	21°22'17.81"N	40°15'41.43"E
1440 T	21°21'44.16"N	40°15'41.47"E
670 T	21°21'14.26"N	40°12'24.98"E
300 M	22°28'40.29"N	39°28'41.66"E
600 M	24°12'1.90"N	39°33'36.36"E
900 M	24°18'54.07"N	39°33'35.76"E

Appendix 2. *Floristic composition of the two studied roads, M: Madina road, T: Taeif road*

Species name	M- Road	T- Road
Abutilon bidentatum	0	1
Abutilon hirtum	0	1
Abutilon pannosum (Forst.f.)Schltdl.	1	0
Acacia ehrenbergiana	1	1
Acacia gerrardii	0	1
Achyranthes aspera	1	1
Adiantum capillus-veneris	0	1
Aerva javanica	1	1
Aerva lanata	0	1
Aizoon canarense	1	1
Amaranthus graecizans L.	1	0
Amaranthus hybridus	0	1
Amaranthus hypochondriacus	0	1
Amaranthus lividus	1	1
Amaranthus spinosus	0	1
Amaranthus viridis	0	1
Anastatica hierochuntia L.	1	0
Andrachane aspera	0	1
Andropogon distachyos	0	1
Apium nodiflorum	0	1
Argemone ochroleuca	0	1
Aristida mutabilis Trin. & Rupr.	1	0
Asparagus africanus	0	1
Asparagus aphyllus	0	1
Asphodelus tenuifolius Cav.	1	0
Astragalus vogelii (Webb)Bornm.	1	0
Atriplex suberecta	0	1
Barleria sp. Nov**	0	1

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Species name	M- Road	T- Road
Bassia muricata (L.) Murray	1	0
Bidens biternata	0	1
Blepharis ciliaris	0	1
Boerhavia coccinea Mill.	1	1
Boerhavia diffusa	1	1
Brachiaria leersioides	0	1
Bromus diandrus	0	1
Calotropis procera	1	1
Capparis cartilaginea	0	1
Carrichtera annua	0	1
Cassia italic	0	1
Caylusea hexagyna (Forssk.)Green	1	0
Cenchrus ciliaris	1	1
Cenchrus pennisetiformis	0	1
Cenchrus setigerus	0	1
Centaurea sinaica	0	1
Chenopodium album	0	1
Chenopodium ambrosoides	0	1
Chenopodium botrys	1	1
Chenopodium murale	1	1
Chenopodium opulifolium	0	1
Chenopodium vulvaria	0	1
Cichorium intybus	0	1
Citrullus colocynthis (L.)Schrad	1	0
Cleome africana Botsch.	1	0
Cleome amblyocarpa	0	1
Cleome chrysantha	1	1
Coccinea grandis	0	1
Coccolus pendulus	0	1
Cometes abyssinica	0	1
Commicarpos grandiflorus	1	1
Commicarpos helenae	0	1
Commicarpos plumbagineus	1	1
Convolvulus arvensis	1	1
Conyza bonariensis	0	1
Corchorus depressus(L.) Stocks.	1	0
Crotalaria emarginella	0	1
Cuscuta planiflora	0	1
*Cymbopogon schoenanthus (*L.) Spreng.	1	0
Cynodon dactylon	1	1
Datura innoxia	0	1
Datura stramonium L.	1	0
*Dianthus sp. ****	0	1
Dianthus strictus	0	1
*Dichanthium annulatum (*Forssk.) Stapf	1	0
Digera muricata (L.) Mart.	1	0
Diplotaxis acris (Forssk.) Boiss.	1	0
Dipterygium glaucum Decne.	1	0
Dodoonia angustifolia	0	1
Echinops erinaceus	1	1
Echinops hystrichoides	0	1

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Species name	M- Road	T- Road
Ephedra alata	0	1
Ephedra foliate	0	1
Eragrostis pilosa	0	1
Erodium cicutarium (L.) L'Her.	1	0
Erodium laciniatum (Cav.) Willd.	1	0
Euphorbia granulata	0	1
Euphorbia ammak	0	1
Euphorbia granulata Forssk.	1	0
Euphorbia hirta	0	1
Euphorbia inaequilatera	0	1
Euphorbia indica	0	1
Fagonia bruguieri	1	1
Fagonia indica	0	1
Farsetia longisiliqua	1	1
Farsetia stylosa	0	1
Ficus carica	0	1
Ficus cordata	0	1
Ficus palmata	0	1
Flaveria trinervia	1	1
Forsskaolea tenacissima	1	1
Glinus lotoides L.	1	0
Gomphocarpus sinaicus	0	1
Grewia tenax	0	1
Grewia trichocarpa	0	1
Gymnarrhena micrantha Desf.	1	0
Gypsophila capillaris (Forssk.) C.Chr.	1	0
Hammada elegans (Bunge) Botsch.	1	0
Helianthemum lippii	0	1
Heliotropium arbainense Fresen.	1	0
Heliotropium bacciferum Forssk.	1	0
Heliotropium curassavicum	0	1
Heliotropium lasiocarpum	0	1
Heliotropium longiflorum	0	1
Hibiscus micranthus	0	1
Hyparrhenia hirta	0	1
Hypoestes forsskaolii	0	1
Ifloga spicata (Forssk.) Sch.-Bip.	1	0
Indigofera articulata Nov***	0	1
Indigofera spinosa Forssk.	1	0
Ipomoea obscura	0	1
Juniperus phoenicea	0	1
Kickxia pseudoscoparia	0	1
Lactuca serriola	0	1
Launaea capitata (Spreng.) Dandy	1	0
Launaea mucronata ssp. cassiniana	0	1
Launaea nudicaulis (L.) Hook.f.	1	1
Lavandula coronopifolia	0	1
Lavandula pubescens	0	1
Lemna gibba	0	1
Leptadenia pyrotechnica	1	1
Leptochloa fusca	0	1

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Species name	M- Road	T- Road
Lindenbergia indica	0	1
Lolium perenne	0	1
Lycium shawii	0	1
Maerua crassifolia Forssk.	1	0
Malva parviflora	1	1
Maytenus heterophylla	0	1
Maytenus parviflora	0	1
Micromeria imbricata	0	1
Morettia canescens	1	1
Ochradenus baccatus	1	1
Olea europaea ssp. *cuspidata*	0	1
Onopordon heteracanthum	0	1
Opuntia ficus-indica	0	1
Osteospermum vaillantii	0	1
Otostegia fruticosa	0	1
Panicum turgidum Forssk.	1	0
Parthenium hysterophorus	0	1
Peganum harmala	0	1
Pennisetum divisum (Forssk. & Gmel.) Henrard	1	0
Pennisetum macrourum	0	1
Pennisetum orientale	0	1
Pennisetum setaceum	0	1
Pergularia daemia	1	1
Phoenix dactyliferae	0	1
Pithecellobium dulce	0	1
Plantago albicans	0	1
Plantago lanceolata	0	1
Pluchea dioscoridis	0	1
Poa bulbosa L.	1	0
Polycarpaea repens (Forssk.) Aschers. & Schweinf.	1	0
Polycarpon tetraphyllum (L.) L.	1	0
Polygala abyssinica	0	1
*Polygonum aviculare***	0	1
Polypogon monspeliensis	0	1
Polypogon viridis	0	1
Portulaca oleracea L.	1	1
Prunus sp.	0	1
Psiadia punctulata	0	1
Pteranthus dichotomus Forssk.	1	0
Pulicaria crispa	1	1
Pulicaria incise	0	1
Pulicaria vulgaris	0	1
Pupalia lappaceae	1	1
Reichardia tingitana (L.) Roth	1	0
Reseda muricata	0	1
Rhazya stricta Decne.	1	0
Rumex dentatus	0	1
Rumex steudelii	0	1
Rumex vesicarius	1	1
Sageretia thea	0	1
Salsola baryosma (Schult.) Dandy	1	0

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Species name	**M- Road**	**T- Road**
Salsola imbricata	0	1
Salsola kali	0	1
Schouwia thebaica Webb	0	0
Scorzonera tortuosissima	0	1
Senecio hoggariensis	0	1
Senna alexandrina Mill.	1	0
Senna italica Mill.	1	0
Setaria viridis	0	1
Sidda alba	0	1
Sisymbrium irio	1	1
Sisymbrium orientale	0	1
Solanum forskaoli	0	1
Solanum glabratum var. sepicula	0	1
Solanum incanum	0	1
Solanum lycopersicum	0	1
Solanum nigrum	0	1
Solanum schimperianum	0	1
Solanum villosum	0	1
Sonchus oleraceus	1	1
Spergularia marina	0	1
Stipa capines	1	0
Stipa parviflora	0	1
Stipagrostis obtuse	0	1
Suaeda monoica Forssk.	1	0
Tamarix nilotica	0	1
Tephrosia purpuria	0	1
Tetrapogon villosus	1	1
Tragus racemosus	1	0
Tribulus macropterus	0	1
Tribulus pentandrus Forssk.	1	0
Tribulus terrestris	1	1
Trichodesma africanum (L.) R.Br.	1	0
Trichodesma trichodesmoides	0	1
Tricholaena teneriffae	0	1
Trigonella stellata Forssk.	1	0
Triumfetta flavescens	0	1
Typha domingensis	0	1
Uritica urins	0	1
Urtica pilulifera	0	1
Verbesina encelioides	0	1
Veronica anagallis-aquatica	0	1
Withania somnifera	0	1
Zaleya pentandra (L.)c. Jeffrey	1	0
Zalyea pentandra	0	1
Zilla spinosa (Turr.) Prantl	1	0
Ziziphus spina-christi	0	1
Zygophyllum simplex L.	1	0

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