The Journal of Animal & Plant Sciences, 26(4): 2016, Page: 1019-1025
ISSN: 1018-7081

FLORISTIC DIVERSITY OF TABUK PROVINCE, NORTH SAUDI ARABIA

K. Al-Mutairi[1], S. A. Al-Shami[1*], Z. Khorshid[1] and M. M. Moawed[1,2]

[1]Biology Department, Faculty of Science, Tabuk University, P. O. Box 741, Tabuk, Saudi Arabia.
[2]Botany Department, Faculty of Science, Ain Shams University, Eygpt.
*Corresponding author E-mail: salshami@ut.edu.sa

ABSTRACT

The present study was aimed to investigate the floristic diversity and phytogeographical distribution of plant species along four sites i.e. Sharma, Alqan, Al-Lwaz Mountains and Alzetah from Tabuk region, Saudi Arabia. A total of 96 species belonging to 75 genera and 38 families (34 dicots and 4 monocots) were recorded. Asteraceae had the highest contribution (12.5% of the total species) followed by Fabaceae (10.42%), Zygophyllaceae (6.25%) and Lamiaceae (5.21%). The life form spectrum of the recorded species showed the prevalence of theorphytes (37%) followed by chamaephytes (32%), geeophytes (13%), hemicryptophytes (10%) and Phanerophytes (8%). The chorological analysis of the recorded species indicated the predominance of monoregional taxa over the other elements. In the same context, the flora of Tabuk region, as reflected by the present study findings, showed that most species belonged to Saharo-Arabian (37.21%), Irano-Turanian (11.63%) and Sudanean (10.47%) elements, and that constitute almost 60% of the total number of plant species. By comparing the plant diversity among the four studied sites, the highest plant diversity was reported in Alqan and Alzetah, while the lowest was reported in Sharma. It was concluded that Tabuk region had remarkable floristic diversity, however, this natural biodiversity hot spot is probably affected by several human activities including woodcutting and development. Therefore, a conservation program should be launched to protect the natural diversity in such important plant area.

Keywords: Floristic diversity, Tabuk, Suadi Arabia, Life forms, Phytogeography.

INTRODUCTION

Saudi Arabia (Lat. 32º 34` N – 16º 83` N, long 34º 36` E – 56` E) is a vast arid desert with an area of about 2, 250,000 sq kms covering the major part of the Arabian Peninsula. Accordingly, xerophytic vegetation makes up the prominent features of the plant life in the kingdom (Zahran, 1982). Several studies have been published on the flora of the country, the most comprehensive is the flora written by Chaudhary and Al-Jowaid (1999) and Chaudhary (2001). Other publications on the flora of Saudi Arabia include the illustrated flowers of Saudi Arabia by Collenette (1999) and a number of reports on regional or local floras of certain parts of the kingdom; examples include the studies of Hosni and Hegazy (1996) on Asir region and Al-Turki (1997) on Al-Qassim region, and Al-Turki and Al-Olyan (2003) and El-Ghanim *et al*. (2010) on Hail region.

Moreover, floristic studies are not only important to know the variety of plants present in an area, but also socio-economically significant. They provide shelter, food, medicine and everything for the human being and other species of that area (Shehata and Galal, 2014).

Due to its large area, Saudi Arabia contains various habitats including mountains, valleys, sandy and rocky deserts and salt pans (Alsherif *et al*., 2013). Tabuk is located in the Northern part of Saudi Arabia and it has an area of 117000 km^2. Although this area has diversity in the habitats such as mountains, oasis and coastal line, there are few studies concerning the plant diversity in this region (Alharbi, 2010; Rajasab, 2011). Generally, climate of this region is considered as arid region (Al-Nafie, 2008).

Despite the previous efforts to describe the plant species in Tabuk region, there is no previous study highlighted the plant life forms and phytogeographical distribution of plants in this area, except the study of Alharbi (2010), which was restricted to Al-Lwaz Mountains. Therefore, the present study was conducted to assess the floristic composition, phytogeographical distribution and plant diversity of the recorded plant species in Tabuk region.

MATERIALS AND METHODS

Floristic analysis: The present study was conducted along four sites; Sharma, Alqan, Al-Lwaz Mountains and Alzetah in Tabuk Province, Saudi Arabia. The plant species were surveyed based on relevés (10 × 10 m), which were distributed randomly along the study sites. The vascular plant species inside the border of the relevé were recorded as presence/absence. In addition, plants rooted outside the border but with branches extending over the sides of the relevé were also included in the sample. The number of relevés merely depends on the area. Life-form spectrum of the recorded species was

determined according to Raunkiaer (1934). Analysis of the phytogeographical range was carried out according to Zohary (1973) and Al-Nafie (2008). Additionally, classification of the flora into chorotypes was carried out following the system of White and Liéonard (1991) that has been suggested for Eastern Africa and Western Asia. Nomenclature and identification of plant species were done according to Chaudhary (2001) and Collenette (1999).Voucher of specimens were deposited in the Herbarium of Faculty of Science, Tabuk University.

Data analysis: Species richness (alpha-diversity) for each vegetation group was calculated as the average number of species per stand. Species turnover (beta-diversity) was calculated as a ratio between the total number of species recorded in a certain vegetation group and its alpha diversity (Whittaker, 1972). Relative evenness or equitability (Shannon-Weaver index) of the importance value of species was expressed as $\hat{H} = -\Sigma^{s}_{i=1}$ Pi (log Pi), where S is the total number of species and Pi is the relative importance value (relative cover) of the i^{th} species. The relative concentration of dominance (Simpson index) is the second group of heterogeniety indices and is expressed by Simpson's index: D= 1/C {C = $\Sigma^{s}_{i=1}$ $(Pi)^2$, where S is the total number of species and Pi is the relative importance value (relative cover) of species} (Magurran, 1988).

RESULTS AND DISCUSSION

In this study, a total of 96 species belonging to 75 genera and 38 families (34 dicots and 4 monocots) were recorded in Tabuk region. The total number of species recorded in this study was lesser than that previously reported by Alharbi (2010) in Al-Lawz Mountains. In addition, this number represented 77.4, and 28.4% of the flora recorded in Hail region by El-Ghanim *et al*. (2010) and Al-Turki and Al-Olyan (2003), respectively as well as 49.0% of those recorded in Northern Saudi Arabia by Osman *et al*. (2014). Moreover, Asteraceae had the highest contribution (12.5% of the total species) followed by Fabaceae (10.42%), Zygophyllaceae (6.25%) and Lamiaceae (5.21%). This was in agreement with Altay *et al*. (2010), Alharbi (2010), El-Ghanim *et al*. (2010) and Seraj *et al*. (2014) in different regions of Saudi Arabia.

From the data of the present study, it was shown that Tabuk region had relatively high plant diversity (Table 2). The percentage of plant families reported in this study contributed to almost 30% of the total plant families recorded from the Saudi Arabia Chaudhary (2001). The recorded species represented about 4.32 % of the total flora recorded in the entire country. A striking feature in Saudi Arabia flora is the large number of genera in proportion to that of the species (about 2.7 species per genus). This is a very low figure compared with the global average which amounts to 13.6 (Chaudhary, 2001). The present study indicated that the flora of Tabuk region goes below the average level of the Saudi Arabian flora where the number of species per genus was 1.28. This means that the flora of Tabuk is relatively rich as the region that has a certain number of species, each of which belongs to a different genus, is relatively more diverse than a region has the same number of species but belongs to a few number of genera (Hawksworth, 1995).

Table 1. Summary of floristic diversity of the Tabuk region, Saudi Arabia.

	Monocotyledones		**Dicotyledones**		
	Number	**%**	**Number**	**%**	**Total**
Families	**4**	**10.53**	**34**	**89.47**	**38**
Genera	**6**	**8**	**69**	**92**	**75**
Species	**9**	**9.38**	**87**	**90.62**	**96**

Table 2. Comparison of floristic diversity in Tabuk region in the present study to the floristic diversity in the entire country of Saudi Arabia.

Location	**Family**	**Genera**	**Species**	**Generic coefficient**
Tabuk region (present study)	38	75	96	1.28
Saudi Arabia (Chaudhary, 2001)	129	816	2223	2.7
Percentage (%)	29.46	9.19	4.32	

The life form spectra provide information, which may help in assessing the response of vegetation to variations in environmental factors (Ayyad and El-Ghareeb, 1982). As illustrated in Figure 1, the floral community in Tabuk region was dominated by therophytes and chamaephytes. However, the phanerophytes constituted the lowest contribution. This is in accordance with Altay *et al*. (2010), Qureshi and Bhatti (2010), Qureshi *et al*. (2011), Nadaf *et al*. (2011), Osman *et al*. (2014) Seraj *et al*. (2014), El-Ghanim

(2010) and Al Wadie (2002) who reported the dominance of therophytes over the other life forms. Based on the study of Mobayen (1996), the dominance of therophyte is due to the prevalence of the Mediterranean climate. Furthermore, it is well known that therophyte plants are considerably adapted to the dryness and less frequency of rainfall as these plants live the vegetative period in the form of seed (Asri, 2003). The main advantage of being annual is to have high degree of plasticity in growth rate, size and phenology and to remain dormant in years of climatic extremes (Khedr *et al*., 2002). The high percentage of therophytes in the present study may be related to the seasonal rainfall (Galal and Fahmy, 2012). Heneidy and Bidak (2001) pointed out that the dominance of therophytes over the other life forms seems to be a response to the hot-dry climate, topographic variation and biotic influence. El-Ghareeb and Rezk (1989) provided evidence that therophytes acquire dominance in less saline and more sandy habitats, while cryptophytes and chamaephytes in more saline habitats. Moreover, the highest number of chamaephytes may be attributed to the ability of species belonging to this life form to resist drought, salinity, sand accumulation and grazing (Danin 1996; Galal and Fahmy 2012).

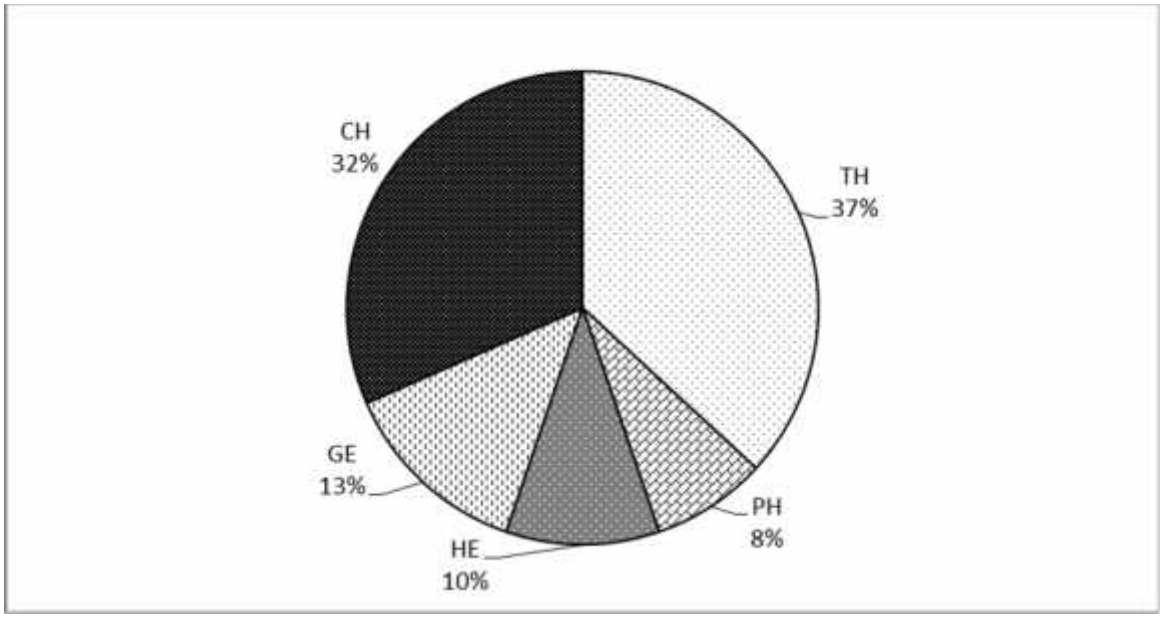

Figure 1. Life form spectrum of the recorded species in Tabuk region, Saudi Arabia. PH: Phanerophytes, CH: Chamaephytes, HE: Hemicryptophytes, GE: Geophytes, TH: Therophytes.

The chorological analysis of the recorded species showed the predominance of monoregional taxa over the other phytogeographical elements (Figure 2). This is in agreement with previous study of Alharbi (2010) in Al-Lawz Mountains. In addition, most of the recorded species in Tabuk region are belonging to the biogeographical (monoregional) regions of Saharo-Arabian, Irano-Turanian and Sudanean. Nadaf *et al*. (2011) reported that Irano-Turanian plants constituted 75.64% of the plants in North Khorasan Province, Iran. Alharbi (2010) found that the plant species in Al-Lawz Mountains were mainly belonged to the Saharo-Sindian Region and Irano-Turanian regions. The present study findings showed that most plant species belong to Saharo-Arabian, Irano-Turanian and Sudanean regions. Thefreore, The plant spceis belong to these three phytogeographical regions constituted almost 60% comapred to other chorotypes. This is in agreement with other studies such as Al Sherif *et al*. (2013) who found that Saharo-Arabian and Sudanian elements had the highest contribution of the total flora in Khulais region, West Saudi Arabia. Similarly, the dominance of Saharo-Arabian and Sudanian elements was also reported in Al-Saoda region South-Western Saudi Arabia (Seraj *et al*., 2014). Moreover, the Saharo-Arabian chorotype decreased northward and replaced by Mediterranean and Irano-Turanian chorotype (Hegazy and Amer, 2001; Danin and Plitman, 1987). This may be attributed to the fact that plants of the Saharo-Arabian species are good indicators for desert environmental conditions, while Mediterranean species stand for more mesic environment (Abdel-Ghani and Amer, 2003).

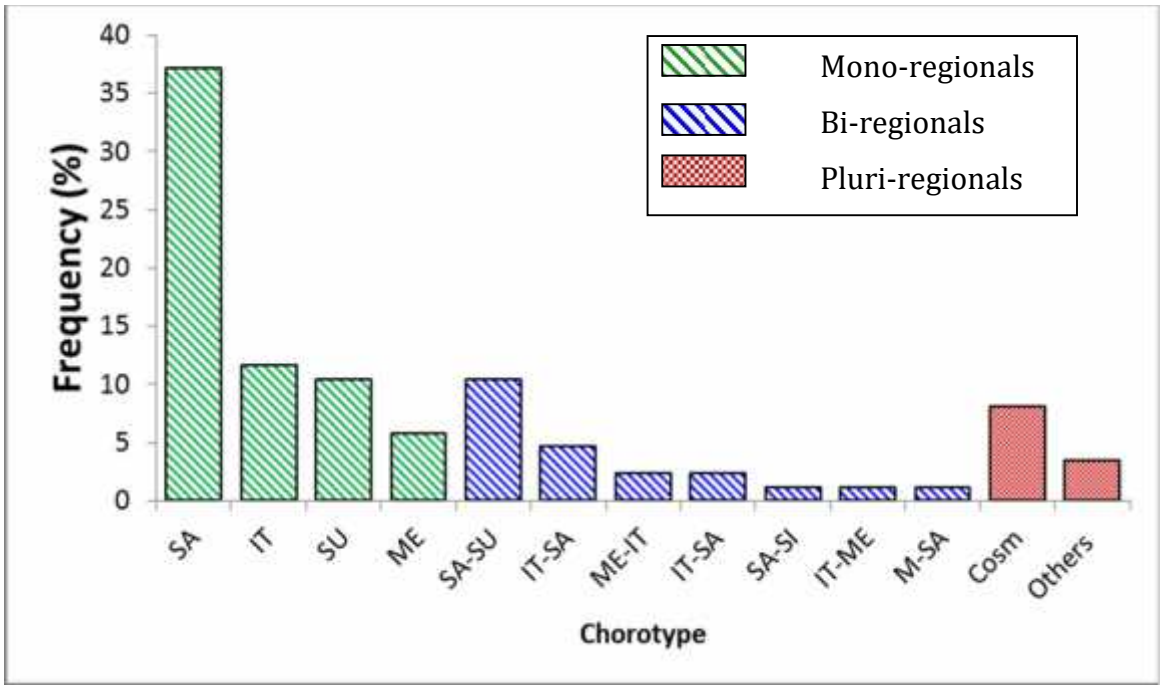

Figure 2. Chorotype analysis of the rcorded species in Tabuk region, Saudi Arabia. SU =Sudanean, SA = Saharo-Arabian, IT = Irano-Turanian, ME = Mediterranean. COSM = Cosmopolitan. Others include Saharo-Arabian- Mediterranean-Euro-Siberian and Saharo-Arabian-Tropical-Sudanean.

The diversity measures in this study showed remarkable plant diversity in two sites as indicated by relatively high Shannon-Weiner and alpha diversity indices (Table 3). The present study indicated that Alqan and Alzetah were the most diverse with the highest number of species (58)as well as species richness, relative eveness and relative concentration of dominance (19.25 species relevé$^{-1}$, 2.94 and 0.947, respectively) were . On the other hand, the highest value of beta diversity (3.65) was recorded at Al-Lawz Mountains. As indicated by several studies that the diversity of natural habitats in Saudi Arabia is the good driver of the high floristic diversity in this region (Alfarhan, 1999). However, compared to other areas, species diversity is low figure from that recorded in Hail region (El-Ghanim *et al*., 2010; Al-Turki and Al-Olyan, 2003) and that recorded in Northern Saudi Arabia (Osman *et al*., 2014). This may be attributed to the high aridity prevailing in the study area. According to Danin (1976), low diversities of vascular plants are expected in extreme deserts, high Arctic and high alpine habitats, salt marshes and mangrove swamps.

Table 3. Diversity measures of the recorded plant species in the four sampled sites in Tabuk region.

Diversity measure	Sharma	Alqan	Al-Lawz	Alzetah
Alpha diversity ($\alpha_{average}$)	15.67±0.88	19.25±1.60	10.4±1.33	19.25±1.60
Beta Diversity ($\beta = \gamma / \alpha_{average}$)	2.233	3.012	3.654	3.012
Gamma diversity (γ)	35	58	38	58
Simpson (D-1)	0.936±0.004	0.947±0.004	0.897±0.013	0.947±0.004
Shannon-Weiner (H')	2.75±0.057	2.94±0.078	2.31±0.125	2.94±0.078

Conclusion: The four studied sites in Tabuk region showed relatively high floristic diversity as indicated by the diversity measures. Therophyte and chamaephyte are the most dominant life forms in Tabuk region. However, in the phytogeographical analysis, most of the collected species belong mainly to three chorotypes; Saharo-Arabian, Irano-Turanianand Sudanean. The low number of species found in this study (compared to other regions in Saudi Arabia) is probably due to intensive human impact (woodcutting and development). Therefore, it is recommended that further ecological studies should be carried out to investigate the influence of geographical and environmental variables on the community structure and plant diversity in this important plant area. It is also recommended that conservation programs should be launched immediately to protect the floristic diversity in this hot spot.

Acknowledgments: The authors express their thanks to Faculty of Science, University of Tabuk for facilitating the data collection and analysis. This study was supported by the Research Grant (s-0038-1436) provided by The Deanship of Scientific Research, University of Tabuk.

REFERENCES

Abdel-Ghani M. M. A. and W. M. Amer (2003). Soil-vegetation relationships in a coastal desert plain of southern Sinai, Egypt. J. Arid Environ. 55(4): 607-628.

Al Wadie H. (2002). Floristic composition and vegetation of Wadi Talha, Aseer mountains, south west Saudi Arabia. J. Biol. Sci. 2(5): 285-288.

Alfarhan A. (1999). A phytogeographical analysis of the floristic elements in Saudi Arabia. Pakistan J. Biol. Sci. 2(3):702-711

Alharbi F. K. (2010). Plant Diversity of Al-Lawz Mountains, Tabuk Region , Saudi Arabia. PhD thesis, King Saud University, Riyadh, Saudi Arabia. (In Arabic with English abstract).

Al-Nafie A. H. (2008). Phytogeography of Saudi Arabia. Saudi J. Biol. Sci.15(1):159-176

Alsherif E. A., A. M. Ayesh and S. M. Rawi (2013). Floristic composition, life form and chorology of plant life at Khulais region, Western Saudi Arabia. Pakistan J. Bot. 45(1):29-38

Altay V., I. I. Ozyigit and C. Yarci (2010). Urban flora and ecological characteristics of the Kartal District (Istanbul): A contribution to urban ecology in Turkey. Sci. Res. Essays 5(2): 183-200.

Al-Turki T. (1997). A preliminary checklist of the flora of Qassim, Saudi Arabia. Feddes Repert. 108(3-4):259-280

Al-Turki T. and H. Al-Olayan (2003). Contribution to the flora of Saudi Arabia: Hail region. Saudi J. Biol. Sci. 10:190-222

Asri Y. (2003). Plant diversity in Touran Biosphere Reserve. Research Institute of Forest and Rangelands, Tehran, Iran, pp 306.

Ayyad M. and R. El-Ghareeb (1982). Salt marsh vegetation of the western Mediterranean desert of Egypt. Vegetatio 49(1): 3-19.

Chaudhary S. A. (2001). Flora of the Kingdom of Saudi Arabia. Ministry of Agriculture and Water, Riyadh, Kingdom of Saudi Arabia.

Chaudhury S. A. and A. Al-Jowaid (1999). Vegetation of the Kingdom of Saudi Arabia. Riyadh: Ministry of Agriculture and Water, Riyadh, Kingdom of Saudi Arabia.

Collenette S. (1999). Wild Flowers of Saudi Arabia. National Commission for Wildlife Conservation and Development, Riyadh, Kingdom of Saudi Arabia.

Danin A. (1976). Plant species diversity under desert conditions. Oecologia 22(3): 251-259.

Danin A. (1996). Plants of Desert Dunes. Springer-Verlag, Berlin.

Danin A. and U. Plitmann (1987). Revision of the plant geographical territories of Israel and Sinai. Plant Syst. Evol. 156(1-2): 43-53.

El-Ghanim W. M. , L. M. Hassan, T. M. Galal and A. Badr (2010). Floristic composition and vegetation analysis in Hail region north of central Saudi Arabia. Saudi J. Biol. Sci. 17(2):119-128

El-Ghareeb R. and M. R. Rezk (1989). A preliminary study on the vegetation of the Mediterranean coastal land at Bousseli (Egypt). J. Univ. Kuwait 16(1):115-128.

Galal T. M. and A. G. Fahmy (2012). Plant diversity and community structure of Wadi Gimal protected area, Red Sea Coast of Egypt. Afri. J. Ecol. 50(3): 266-276.

Hawksworth D. L. (1995). Biodiversity: measurement and estimation, vol 345. Springer Science and Business Media.

Hegazy A.K. and W. M. Amer (2001). Altitudinal and latitudinal diversity of the flora on the Eastern and Western sides of the Red Sea. Proceedings of the Third IUPAC—International Conference on Biodiversity, 3–8 November 2001, Antalya, Turkey.

Heneidy S. Z., L. M. Bidak (2001). Multipurpose plant species in Bisha Asir southwestern Saudi Arabia. J. King Saud Univ. 13: 11-26.

Hosni H. A., A. K. Hegazy (1996). Contribution to the flora of Asir, Saudi Arabia. Candollea 51(1): 169-202.

Khedr A.H., M. W. Cadotte, A. El-Keblawy and J. Lovett-Doust (2002). Phylogenetic diversity and ecological features in the Egyptian flora. Biodivers. Conser. 11(10):1809-1824

Magurran A.E. (1988). Ecological diversity and its measurements. Croom. Helm., London, UK.

Mobayen S. (1996). Flora of Iran 1980-1996. Vol. 1-4, Tehran University Press, Tehran, Iran.

Nadaf M., M. Mortazavi and M. Halimi (2011). Flora, life forms and chorotypes of plants of Salok protected area (North Khorassan Province Iran). Pakistan J. Biol. Sci. 14(1):34-40

Osman A. K., F. Al-Ghamdi and A. Bawadekji (2014). Floristic diversity and vegetation analysis of Wadi Arar: A typical desert Wadi of the Northern Border region of Saudi Arabia. Saudi J. Biol. Sci. 21 (6): 554–565.

Qureshi R., G.R. Bhatti and G. Shabbir (2011). Floristic inventory of Pir Mehr Ali Shah Arid Agriculture University Research Farm at Koont and its

surrounding areas. Pakistan J. Bot. 43 (3): 1679-1684.

Qureshi R. and G.R. Bhatti (2010). Floristic inventory of Pai Forest, Nawab Shah, Sindh, Pakistan. Pakistan J. Bot. 42(4): 2215-2224.

Rajasab A. H. (2011). A Pictorial guide to the plants of Tabuk Region, Saudi Arabia: and their traditional uses. Lambert Academic Publishing, Germany.

Raunkiaer C. (1934). The life forms of plants and statistical plant geography. pp. xvi. 632 pp. Translated by Fausboll C., A. Tansley, Oxford University Press, Oxford.

Seraj S. S., R. N. Jrais and S. K. Ayyad (2014). Floristic Composition, Life Form and Chorology of Plant Life at Al-Saoda, Asir Region, South-Western Saudi Arabia. J. Biol., Agri. Healthc. 4(26): 60-65.

Shehata H. S. and T. M. Galal (2014). Factors affecting the distribution and associated species of Malva parviflora in the Nile Delta, Egypt. Weed Biol. Manag. 15: 42-52.

White F. and J. Leonard. (1991). Phytogeographical links between Africa and Southwest Asia. Fl. Veg. Mundi. 9: 229-246.

Whittaker R. H. (1972). Evolution and measurement of species diversity. Taxon 21: 213-251.

Zahran M. (1982). Vegetation Types of Saudi Arabia. King Abdel Aziz University Press, Jeddah, Saudi Arabia.

Zohary M. (1973). Geobotanical foundations of the Middle East. Vol. 1–2, Gustav Fischer Verlag, Stuttgart, Germany.

Appendix A: List of the reported plant species in Tabuk Region, Saudi Arabia

Taxa	Specimen No.	Family	Life form
Hygrophila auriculata (Schumach.) Heine	HYGT1	Acanthaceae	TH
Aizoon canariense L.	AIZT1	Aizoaceae	TH
Aerva javanica (Burm. f.) Juss. ex J.A. Schultes	AERT1	Amaranthaceae	CH
Deverra tortuosa (Desf.) DC.	DEVT1	Apiaceae	CH
Ferula sinaica Boiss.	FERT1	Apiaceae	HE
Caralluma europaea (Guss.) N.E.Br.	CART1	Asclepediaceae	CH
Asphodelus tenuifolius Cav.	ASPT1	Asphodelaceae	HE
Artemisia herba-alba Asso.	ARTT1	Asteraceae	CH
Artemisia judaica L.	ARTT12	Asteraceae	TH
Atractylis carduus (Forssk.) C.Chr.	ATRT1	Asteraceae	CH
Centaurea procurrens Spreng.	CENT1	Asteraceae	CH
Centaurea sinaica DC.	CENT2	Asteraceae	HE
Echinops glaberrimus DC.	ECHT1	Asteraceae	CH
Launaea spinosa (Forssk.) Kuntze	LAUT1	Asteraceae	TH
Picris cyanocarpa Boiss.	PICT1	Asteraceae	CH
Pulicaria incisa (Lam.) DC.	PULT1	Asteraceae	TH
Scorzonera tortuosissima Boiss.	SCOT1	Asteraceae	CH
Senecio glaucus L.	SENT1	Asteraceae	CH
Tanacetum sinaicum (Fresen.) Delile ex Bremer & Humphries	TANT1	Asteraceae	TH
Alkanna orientalis (L.) Boiss.	ALKT1	Boraginaceae	CH
Gastrocotyle hispida (Forssk.) Bunge	GAST1	Boraginaceae	CH
Heliotropium crispum Desf.	HELT1	Boraginaceae	TH
Trichodesma africanum (L.) R. Br.	TRIT1	Boraginaceae	TH
Diplotaxis harra Forssk.	DIPT1	Brassicaceae	CH
Eremobium aegyptiacum (Spreng.) Asch.	ERET1	Brassicaceae	CH
Eremobium lineare (Delile) Boiss.	ERET2	Brassicaceae	CH
Heliotropium europaeum L.	HELT1	Brassicaceae	TH
Morettia canescens Boiss.	MORT1	Brassicaceae	CH
Morettia parviflora Boiss.	MORT2	Brassicaceae	TH
Zilla spinosa subsp. *spinosa* (L.) Prantl	ZILT1	Brassicaceae	TH
Cleome amblyocarpa Barratte & Murb.	CLET1	Capparaceae	CH
Cleome arabica L.	CLET2	Capparaceae	CH
Polycarpaea robbairea (Kunze) Greuter & Burdet.	POLT1	Caryophyllaceae	CH
Gymnocarpos decandrus Forssk.	GYMT1	Caryophyllaceae	HE
Gypsophila viscosa Murray	GYPT1	Caryophyllaceae	GE
Silene villosa Forssk.	SILT1	Caryophyllaceae	PH
Halocnemum strobilaceum (Pall.) Bieb.	HALT1	Chenopodiaceae	PH
Haloxylon salicornicum (Moq.) Bunge ex Bioss.	HALT2	Chenopodiaceae	TH

Helianthemum lippii (L.) Pers.	HELT2	Cistaceae	TH
Convolvulus buschiricus Bomm.	CONT1	Convolvulaceae	HE
Umbilicus intermedius Boiss.	UMBT1	Crassulaceae	TH
Citrullus colocynthis (L.) Schrad.	CITT1	Cucurbitaceae	TH
Juniperus phoenicea L.	JUNT1	Cupressaceae	CH
Ephedra aphylla Forssk.	EPHT1	Ephedraceae	PH
Euphorbia retusa Forssk.	EUPT1	Euphorbiaceae	TH
Astragalus eremophilus Boiss.	ASTT1	Fabaceae	TH
Astragalus palaestinus Eig	ASTT2	Fabaceae	TH
Astragalus spinosus (Forssk.) Muschl.	ASTT3	Fabaceae	HE
Astragalus tribuloides Delile	ASTT4	Fabaceae	GE
Crotalaria aegyptiaca Benth.	CROT1	Fabaceae	GE
Lotus glinoides Delile	LOTT1	Fabaceae	CH
Medicago laciniata (L.) Miller	MEDT1	Fabaceae	CH
Ononis natrix L.	ONOT1	Fabaceae	CH
Retama raetam subsp. *raetam* (Forssk.) Webb.	RETT1	Fabaceae	HE
Trigonella anguina Delile	TRIT2	Fabaceae	CH
Erodium laciniatum (Cav.) Willd.	EROT1	Geraneaceae	GE
Erodium oxyrhynchum M.Bieb.	EROT2	Geraniaceae	GE
Monsonia nivea (Decne.) Decne. ex Webb	MONT1	Geraniaceae	GE
Bellevalia flexuosa Boiss.	BELT1	Hyacinthaceae	TH
Gynandriris sisyrinchium (L.) Parl.	GYNT1	Iridaceae	PH
Lavandula coronopifolia Poir.	LAVT1	Lamiaceae	TH
Lavandula Pubescens Herbs	LAVT2	Lamiaceae	GE
Otostegia fruticosa Forssk.	OTOT1	Lamiaceae	HE
Stachys aegyptiaca Pers.	STAT1	Lamiaceae	TH
Teucrium polium L.	TEUT1	Lamiaceae	TH
Colchicum tunicatum Feinbr	COLT1	Liliaceae	CH
Gagea reticulata (Pall.) Schult. & Schult.f.	GAGT1	Liliaceae	TH
Colchicum ritchii R.Br.	COLT2	Liliaceae	TH
Gagea commutata K. Koch	GAGT2	Liliaceae	CH
Malva neglecta Wallr.	MALT1	Malvaceae	CH
Acacia tortilis (Forssk.) Hayne	ACAT1	Mimosaceae	PH
Neurada procumbens L.	NEUT1	Neuradaceae	TH
Cistanche salsa (C. A. Mey) G. Beck.	CIST1	Orobanchaceae	CH
Peganum harmala L.	PAGT1	Peganaceae	TH
Plantago ciliata Desf.	PLAT1	Plantaginaceae	HE
Bromus sericeus Drobow	BROT1	Poacea	TH
Stipa lagascae R. & Sch.	STIT1	Poacea	TH
Stipa obtusa (Nees & Meyen) Hitchcock	STIT2	Poacea	PH
Rumex cyprius Murb.	RUMT1	Polygonaceae	CH
Caylusea hexagyna (Forssk.) M. L. Green	CAYT1	Resedaceae	TH
Ochradenus baccatus Delile.	OCHT1	Resedaceae	CH
Reseda muricata C. Presl	REST1	Resedaceae	CH
Reseda pruinosa Del.	REST2	Resedaceae	CH
Kickxia floribunda (Boiss.) Täckh. & Boulos	KICT1	Scrophulariaceae	CH
Kickxia scoparia Kunkel	KICT2	Scrophulariaceae	TH
Verbascum sinaiticum Benth.	VERT1	Scrophulariaceae	TH
Hyoscyamus desertorum (Aschers. ex Boiss.) Taeckh.	HYOT1	Solanaceae	TH
Hyoscyamus pusillus L.	HYOT2	Solanaceae	TH
Lycium depressum Stocks	LYCT1	Solanaceae	TH
Lycium shawii Roem. & Schult.	LYCT2	Solanaceae	TH
Parietaria alsinifolia Delile	PART1	Urticaceae	TH
Fagonia arabica var. *Arabica* (L.) T. Anderson	FAGT1	Zygophyllaceae	TH
Fagonia bruguieri DC.	FAGT2	Zygophyllaceae	TH
Fagonia glutinosa Delile	FAGT3	Zygophyllaceae	TH
Fagonia mollis var. *hispida* Zohary	FAGT4	Zygophyllaceae	TH
Seetzenia lantana (Wild) Bullock	SEET1	Zygophyllaceae	TH
Tribulus terrestris L.	TRIT2	Zygophyllaceae	TH