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RESEARCH ARTICLE

FLORISTIC PERSPECTIVE FOR SOME MEDICINAL PLANTS GROWING IN THE COASTAL AND INLAND DESERTS OF EGYPT

Ibrahim A. Mashaly, *Mohamed Abd El-Aal, Heshmat S. Aldesuquy and Baedaa A. Mahdee

Department of Botany, Faculty of Science, Mansoura University, Mansoura, 35516, Egypt

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ABSTRACT

This study aimed at characterizing the floristic features of plant species associated with four wild medicinal plants in the Egyptian deserts. Two plants were chosen from the inland north part of the Eastern desert (Wadi Hagul and Wadi El-Molak) namely *Pulicaria undulata* (L.) C. A. Mey. and *Hyoscyamus muticus* L., and the two other species were selected from the coastal desert along the Deltaic Mediterranean Sea coast namely *Calligonum polygonoides* L. subsp. *comosum* and *Nicotiana glauca* R.C. Graham. A total of 125 plant species belonging to 107 genera and 29 families were recorded. Asteraceae, Poaceae, Chenopodiaceae and Brassicaceae were the leading families which represented by 55.2% of the total number of recorded species. Preponderance of perennials, therophytes and Saharo-Sindian/ Mediterranean taxa indicating the semi-arid and arid climateof the study area. Four vegetation groups or community types were yielded after TWINSPAN and named after the first dominant species. Group A: *Zygophyllum coccineum*, group B: *Pulicaria undulata*, group C: *Calligonum polygonoides* and group D: *Nicotiana glauca*. *Z. coccineum* community dominated Wadi Hagul bed. *P. undulata* community occupied Wadi El-Molak bed. *C. polygonoides* community dominated the roadside and sand formation habitats. Furthermore, *N. glauca* community inhabited roadside of the coastal desert. In addition, these communities were apparently segregated along DCA-axes.

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INTRODUCTION

The interest of ecologist in the last decade is the knowledge the current status of the medicinal plants inhabiting desert ecosystem. This interest is due to serious of recently recorded human-induced threats, putting those plants in the way of extinction. The desert is a unique ecosystem that provides human with basic needs and services. Egyptian deserts occupy about 95% of the total area. The desert vegetation comprises a hundred of annuals and perennials species which could be considered the backbone for the sustainable development of these deserts. The desert vegetation is the most characteristic and important type of the natural plant wealth in this country and includes mainly of xerophytic shrubs and sub-shrubs (Zahran and Willis, 2009). Ecologically, Egyptian deserts are classified into two types; coastal and inland deserts. Coastal deserts are adjacent to the sea coast (Mediterranean or Red Seas) and constitute the interface between land and sea. These deserts are among the most reproductive systems in the world and provide a disproportionately more services relating to human well-being than most other systems even those covering larger total areas (Millennium Ecosystem Assessment, 2005). However, many of recently recorded human activities result in more or less sever impacts on the coastal ecosystems. These activities include urbanization, pollution, and tourism resorts. Therefore, coastal ecosystems could be managed and preserved for future generations (Teresa *et al*., 2013). In contrast, the inland deserts are far away the maritime effects and characterized by a hot arid climate with low rainfall. This inland ecosystem includes true xerophytic vegetation (Zahran and Willis, 2009). Approximately 85% of the world's population relies on traditional medical treatments based on plant remedies, and around 25% of the world's pharmaceutical medicines demands are derived from plants. According to the World Health Organization, approximately 3.5 billion people in developing countries believe in the efficiency of plant remedies and use them regularly, and it has also been estimated that up to 90% of the population in developing countries rely on the use of medicinal plants to help meet their primary health care needs (WHO, 2002).

Corresponding author: Mohamed Abd El-Aal,
Department of Botany, Faculty of Science, Mansoura University, Mansoura, 35516, Egypt.

In most developing countries, uncontrolled trade of medicinal plant, over-cutting, over-collecting, overexploitation and habitat loss are the primary threats to medicinal plant resources (IUCN, 2002). Most of the plants used in traditional medicine are collected from the wild, and only a few have been domesticated (IUCN, 2001). Concerning economic potentialities, the flora of the Egyptian deserts could be categorized under 5 main groups; drug, fodder, fiber, oil-perfume and wood-fuel producing plants (Zahran and Willis, 2009). In the present study, four wild medicinal plants were selected with aim of assessing the floristic composition of their associates in the Deltaic Mediterranean coastal desert and in Wadi Hagul and Wadi El-Molak in the inland desert of the north part of the Eastern Desert. *Calligonum polygonoides* L. subsp. *comosum* (L' Her.) Soskov is a xerophytic perennial shrub belonging to family Polygonaceae. It inhabits sandy deserts, sandy dunes in northeast Africa and Middle East (Boulos, 1999). The uses of this plant includes, smokeless firewood, sand stabilizers, windbreaks, food colorant and as a feed for animals. Medicinally, it used for treatment of stomach ailment, typhoid and gut sores (Taia and El-Etaby, 2006). *Nicotiana glauca* R.C. Graham (wild tobacco) is a shrub or small tree, a member of family Solanaceae and native to Argentina. This plant is widespread in disturbed soil, roadside and may even found in gardens as ornamental plant (Boulos, 2002). *N. glauca* is poisoning for livestock and birds. It contains the piperidine-pyridine alkaloid, anabasine, which is closely related to nicotine (Botha *et al*., 2011). *Hyoscyamus muticus* L. is a stout succulent perennial herb or shrub belonging also to family Solanaceae. It is widely distributed in deserts of arid lands (Boulos, 2002). It is rich with tropane alkaloids, hyoscyamine and scopolamine. These alkaloids exhibit a wide range of pharmaceutical and toxic activities including antiemetic, mydriatic, antispasmodic and in treatment of motion sickness (El-Shazly *et al*., 1997). *Pulicaria undulata* (L.) C.A.Mey. subsp. *undulata* is a species of family Asteraceae. *P undulata* is a low shrub with cushion-shaped, widely distributed in desert wadis, sandy and alluvial plains, edges or reclaimed desert lands (Boulos, 2002). The oil of *P. undulata*is rich in phenolic compounds, monoterpene hydrocarbons and has insecticidal and antibacterialactivities (Al-Hajj *et al*., 2014). This study aimed at characterizing the floristic features of the plant species associated with four selected medicinal plants that growing naturally in the Deltaic Mediterranean coastal land and in north of Eastern desert of Egypt.

The study area

The sampled stands were distributed in two types of deserts in Egypt; the coastal and inland deserts (Fig 1). The coastal desert part is represented by two locations namely, Gamasa coastal land (Dakahlyia Province) and Baltim coastal land (Kafr El-Sheikh Province). These coastal lands extend along the Deltaic Mediterranean Sea coast. On the other hand, the inland desert part is represented by two locations namely, Wadi Hagul and Wadi El-Molak in the North Eastern desert of Egypt. The climate of the coastal desert of the Mediterranean Sea is semi-arid with hot summer and mild winter, the mean annual temperature ranges between 20-35 °C and the annual rainfall varies from 8.9 mm to 14.6 mml (Baltim meteorological station according to Climatic Normal of Egypt); whereas the inland desert is arid with temperature ranges from 14˚C to 21.7˚C in winter and from 23.1˚C to 46.1˚C in summer and the annual rainfall ranges between 3.5 to 25 mm (Suez meteorological station).

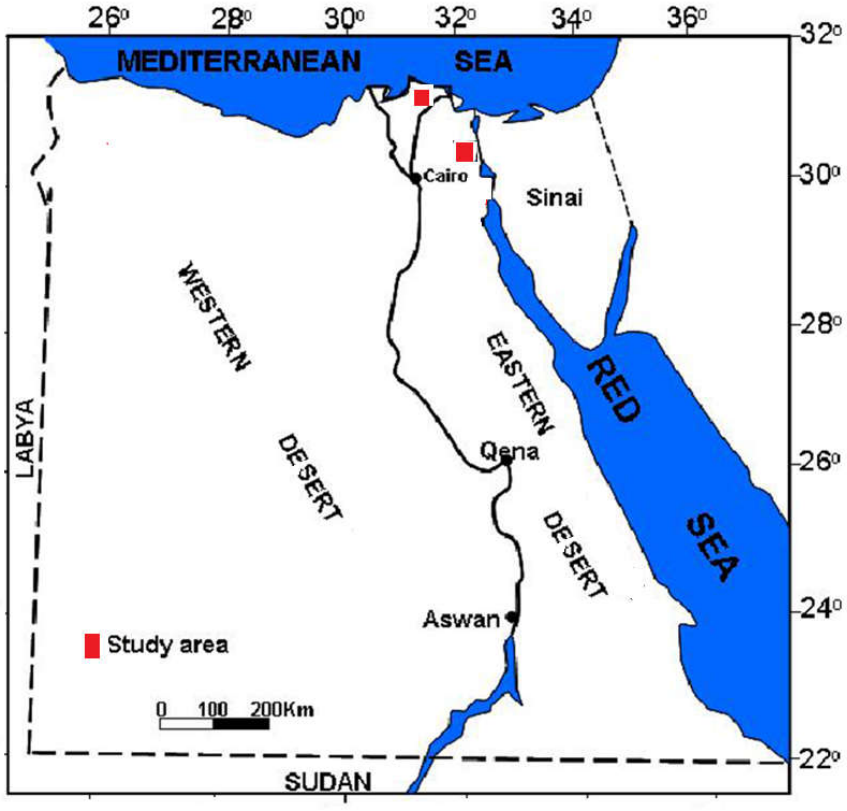

Figure 1. Map of Egypt showing the study area

Calligonum polygonoides and *Nicotiana glauca* were collected from the coastal desert of the Deltaic Mediterranean Sea coast, while *Hyoscyamus muticus* and *Pulicaria undulate* were collected from the inland desert (Wadi Hagul and Wadi El-Molak in the North Eastern desert).

MATERIALS AND METHODS

Vegetation sampling and analysis

Thirty-five stands (5x5 m each) were selected for analyzing the vegetation types of the associates for the studied plants in the study area. By sum of relative density (Shukla and Chandel, 1989) and relative cover (Canfield, 1941) in each stand, the importance value was calculated for each species which is out of 200. Nomenclature of species was according to Boulos (1999, 2000, 2002, 2005, 2009). Life-forms of the recorded species were categorized according to scheme of Raunkiaer (1934). Analysis of the floristic categories was applied according to Zohary (1966, 1972) and Feinbrun-Dothan (1978, 1986). The voucher specimens were deposited in the Herbarium of Botany Department, Faculty of Science, Mansoura University, Egypt.

Data analysis

Two Way Indicator Species Analysis (TWINSPAN) was used to classify the floristic data of 35 stands into groups, using CAP program version 1.2 (Henderson and Seaby, 1999), while Detrended Correspondence Analysis (DCA) was applied to ordinate the stands position along the first 2 axes (Ter Braak, 2003).

RESULTS

Floristic features

A total of 125 vascular plant species (64 perennials, 59 annuals and 2 biennials) belonging to 107 genera and classified under 29 families were recorded (Table 1). The largest representative families were Asteraceae (26 species), Poaceae (20), Chenopodiaceae (12) and Brassicaceae (11 species). *Zygophyllum* was the largest genus represented by four species. No endemic species were recorded in the study area. As shown in Fig 2, the life-form spectrum of the 125 recorded species included therophytes (61 species=48.8 %), chamaephytes (29 species=23.2%), hemicryptophytes (14 species=11.2%), cryptophytes (12 species=9.6%), phanerophytes (6.4 %) and parasites (0.8%). Regarding the floristic categories, the geographical distribution of the recorded species (after excluding the three cultivated species) as presented in Table (2) and Fig (3) revealed that, 49 species (39.2% of the total number of recorded species) were biregional elements, 38 pluriregional (30.4%) and 37 monoregional (29.6%) elements. Out of 69 Saharo-Sindian elements, 24 species were mono Saharo-Sindian, 35 species biregional (either with Mediterranean, Sudano-Zambezian or Irano-Turanian taxa) and 10 pluriregional species. The Mediterranean element is represented by 63 species (50.4% of the total number of recorded species), out of them, 13 species were monoregional Mediterranean taxa, 30 species biregional elements that extends in their distribution either in Saharo-Sindian (17 species), Irano-Turanian (7 species), Euro-Siberian (4 species) or palaeotropic elements (2 species) and 20 species pluriregional elements in which the Mediterranean element is extending either in Irano-Turanian, Euro- Siberian, Saharo-Sindian or Sudano-Zambezian elements.

Table 1. Species composition in the study area with their Families, life span, life form and chorotypes. Ann: annuals; Per: perennials; Bi: biennials; Th: therophyte; Ch: chamaephyte; H: hemicryptophytes; Ph: phanerophytes; Cr: cryptophytes; P: parasites; ME: Mediterranean; SA-SI: Saharo-Sindian; IR-TR: Irano-Turanian; S-Z: Sudano-Zambezian; ER-SR: Euro-Siberian; PAL: Palaeotropical, COSM: Cosmopolitan; PAN: Pantropical; NEO: Neotropical; CULT and Nat: cultivated and naturalized

Plant species	Life span	Life form	Chorotype
Aizoaceae			
Aizoon canariensis L.	Ann.	Th	SA-SI+S-Z
Mesembryanthemum crystallinum L.	Ann.	Th	ME+ER-SR
M. nodiflorum L.	Ann.	Th	ME+SA-SI+ER-SR
Amaryllidaceae			
Pancratium maritimum L.	Per.	Cr	ME
Apiaceae			
Daucus litoralis Sm.	Ann.	Th	ME
Deverra tortuosa (Desf.) DC.	Per.	Ch	SA-SI
Pseudorlaya pumila (L.) Grande	Ann.	Th	ME
Asclepiadaceae			
Cynanchum acutum L.	Per	H	ME+IR-TR
Leptadenia pyrotechnica (Forrsk.) Decne.	Per.	Ph	SA-SI
Pergularia tomentosa L.	Per.	Ch	SA-SI
Asteraceae			
Achillea fragrantissima (Forssk.) Sch.Bip.	Per	Ch	SA-SI+IR-TR
Atractylis carduus (Forssk.) C.Chr.	Per	H	ME+SA-SI
Carduus pycnocephalus L.	Ann.	Th	ME+IR-TR
Carthamus tenuis (Boiss & Blanche) Bornm.	Ann.	Th	ME
Centaurea aegyptiaca L.	Bi.	Th	SA-SI
Conyza aegyptiaca (L.) Dryand.	Ann.	Th	ME
C. bonariensis (L.) Cronquist	Ann	Th	ME
Echinops spinosus L.	Per.	H	ME+SA-SI
Ifloga spicata (Forssk.) Sch. Bip. subsp. *spicata*	Ann.	Th	ME+SA-SI
Iphiona mucronata (Forssk.) Asch.	Per.	Ch	SA-SI

Lactuca serriola L.	Ann.	Th	ME+IR-TR+ER-SR
Launaea mucronata (Forssk.) Muschl.	Per.	H	ME+SA-SI
L. nudicaulis (L.) Hook.f.	Per.	H	SA-SI
L. spinosa (Forssk.)Sch.Bip. ex Kuntze	Per.	Ch	SA-SI
Limbarda crithmoides (L.) Dumort.	Per.	Ch	ME+ER-SR+SA-SI
Nauplius graveolens (Forssk.) Wilklund	Per.	Ch	SA-SI
Pluchea dioscoridis (L.) DC.	Per.	Ph	SA-SI+S-Z
Pulicaria incisa (Lam.) DC.	Per.	Ch	SA-SI
P. undulata (L.) C.A.Mey. subsp. *undulata*	Per.	Ch	SA-SI+S-Z
Reichardia tingitana (L.) Roth.	Ann.	Th	ME+SA-SI+IR-TR
Senecio glaucus L.	Ann.	Th	ME+SA-SI+IR-TR
Silybum marianum (L.) Gaertn.	Ann.	Th	ME+IR-TR+ER-SR
Sonchus oleraceus L.	Ann.	Th	COSM
Symphyotrichum squamatum (Spreng.) Nesom	Per.	Ch	NEO
Urospermum picroides (L.) F.W. Schmidt	Ann.	Th	ME+IR-TR
Xanthium strumarium L.	Ann.	Th	COSM
Boraginaceae			
Anchusa humilis (Desf.) I.M. Johnst.	Ann.	Th	ME+SA-SI
Heliotropium digynum (Forssk.) Christens	Per.	Ch	SA-SI
Trichodesma africanum (L.) R.Br.	Per.	Ch	SA-SI+S-Z
Brassicaceae			
Brassica nigra (L.) Koch	Ann.	Th	COSM
B. rapa L.	Ann.	Th	NAT and CULT
B. tournefortii Gouan	Ann.	Th	ME+IR-TR+SA-SI
*Cakile maritima*Scop.	Ann.	Th	ME+ER-SR
Diplotaxis harra (Forssk.) Boiss.	Per.	H	ME+SA-SI
Farsetia aegyptia Turra.	Per.	Ch	SA-SI+S-Z
Lobularia libyca (Viv.) C.F. W. Meissn.	Ann.	Th	SA-SI
Mathiola longipetala (Vent.) DC.	Ann.	Th	ME+IR-TR
Raphanus raphanistrum L.	Ann.	Th	ME+ER-SR
Sisymbriumirio L.	Ann.	Th	ME+IR-TR+ER-SR
Zilla spinosa (L.) Prant.	Per.	Ch	SA-SI
Caryophyllaceae			
Gypsophila capillaris (Forssk.) C. Chr.	Per.	H	SA-SI+IR-TR
Herniaria hemistemon J. Gay	Per.	H	ME+SA-SI
Paronychia arabica (L.) DC.	Ann.	Th	SA-SI+ME+S-Z
Silene viviani Steud.	Ann.	Th	ME+SA-SI
Spergularia marina (L.) Griseb	Bi.	Th	ME+IR-TR+ER-SR
Chenopodiaceae			
Anabasis articulata (Forssk.) Moq.	Per.	Ch	SA-SI+IR-TR
Arthrocnemum macrostachyum (Moric.) K.Koch	Per.	Ch	ME+SA-SI
Atriplex halimus L.	Per.	Ph	ME+SA-SI
*A. semibaccata*R.Br.	Per	H	AUST
Bassia indica (Wight) A.J.Scott	Ann.	Th	S-Z+IR-TR
B. muricata (L.) Ach.	Ann.	Th	SA-SI+IR-TR
Chenopodium album L.	Ann.	Th	COSM
C. murale L.	Ann.	Th	COSM
Cornulaca monocantha Delile	Per.	Ch	SA-SI+IR-TR
Haloxylon salicornicum (Moq.) Bunge	Per.	Ch	SA-SI
Salsola kali L.	Ann.	Th	COSM
Suaeda maritima (L.) Dumort.	Ann.	Th	COSM
Convolvulaceae			
*Convolvulus lanatus*Vahl.	Per.	Ch	SA-SI
Cyperaceae			
Cyperus capitatus Vand.	Per.	Cr	ME
Euphorbiaceae			
Ricinus communis L.	Per.	Ph	NAT and CULT
Fabaceae			
Alhagi graecorum Boiss.	Per.	H	PAL
*Crotalaria aegyptiaca*Benth.	Per.	Ch	SA-SI

Continue…….

Lotus halophilus Boiss. &Spruner	Ann.	Th	ME+SA-SI
Medicago intertexta (L.) Mill.	Ann.	Th	ME+ER-SR
Melilotus indicus (L.) All.	Ann.	Th	ME+IR-TR+SA-SI
Ononis serrata Forssk.	Ann.	Th	ME+SA-SI
Geraniaceae			
Erodium laciniatum (Cav.) Willd.	Ann.	Th	ME
Juncaceae			
Juncus acutus L.	Per.	Cr	ME+IR-TR+ER-SR
J. rigidus Desf.	Per.	Cr	ME+SA-SI+IR-TR
Lamiaceae			
Lavandula coronopifolia Poir.	Per.	Ch	SA-SI
Salvia deserti Decne.	Per.	Ch	SA-SI+IR-TR
Malvaceae			
Malva parviflora L.	Ann.	Th	ME+IR-TR
Neuradaceae			
Neurada procumbens L.	Ann.	Th	SA-SI+IR-TR
Orobanchaceae			
Cistanche phelypaea (L.) Cout.	Per.	P	ME+SA-SI
Plantaginaceae			
Plantago lagopus L.	Ann.	Th	ME
Poaceae			
Aegilops bicornis (Forssk.) Jaub & Spach	Ann.	Th	ME+SA-SI
A. kotschyi Boiss.	Ann.	Th	IR-TR+ SA-SI
Avena fatua L.	Ann.	Th	PAL
Bromus diandrus Roth	Ann.	Th	ME
Cutandia memphitica (Spreng.) Benth.	Ann	Th	ME+IR-TR+SA-SI
Cynodon dactylon (L.) Pers.	Per.	Cr	PAN
Elymus farctus (Viv.) Runem. ex Melderis	Per.	Cr	ME
Hordeum murinum L.	Ann.	Th	ME+IR-TR+ER-SR
Imperata cylindrica (L.) Raeusch.	Per.	H	PAL+ME
Lasiurus scindicus Henrard.	Per.	Cr	SA-SI+S-Z
Lolium multiflorum Lam.	Ann.	Th	ME+IR-TR+ER-SR
L. perenne L.	Ann.	Th	ME+IR-TR+ER-SR
Panicum turgidum Forssk.	Per.	H	SA-SI
Parapholis incurve (L.) C.E. Hubb	Ann.	Th	ME+IR-TR+ER-SR
Phalaris minor Retz.	Ann.	Th	ME+IR-TR
Phragmites australis (Cav.) Trin. ex Steud.	Per.	Cr	COSM
Polypogon monspeliensis (L.) Desf.	Ann.	Th	COSM
Saccharum spontaneum L.	Per.	Cr	PAL+ME
Sporobolus spicatus (Vahl) Kunth	Per.	Cr	S-Z+SA-SI+ME
Stipagrostislanata (Forssk.) De Winter	Per.	Cr	SA-SI
Polygonaceae			
Calligonum polygonoides L. subsp. *comosum*(L' Her.)Soskov	Per.	Ph	SA-SI+IR-TR
Emex spinosa (L.) Campd.	Ann.	Th	ME+SA-SI
Polygonumequisetiforme Sibthi& Sm.	Per.	Cr	ME+IR-TR
Rumex dentatus L.	Ann.	Th	ME+IR-TR+ER-SR
R. pictus Forssk.	Ann.	Th	ME+SA-SI
Resedaceae			
*Ochradenus baccatus*Delile	Per	Ph	SA-SI
Reseda decursiva Forssk.	Ann.	Th	SA-SI
Rutaceae			
Haplophyllum tuberculatum (Forssk.) A. Juss.	Per.	H	SA-SI
Scrophulariaceae			
Kickxia aegyptiaca (L.) Nabelek.	Per.	Ch	ME+SA-SI
Solanaceae			
Hyoscyamus muticus L.	Per.	Ch	SA-SI
Nicotiana glauca R.C. Graham	Per.	Ph	NAT and CULT
Solanum nigrum L.	Ann.	Th	COSM
Tamaricaceae			
Tamarix nilotica (Ehrenb). Bge	Per.	Ph	SA-SI+S-Z
Urticaceae			
Forsskaolea tenacissima L.	Per.	H	SA-SI+S-Z
Zygophyllaceae			
Fagonia arabica L.	Per.	Ch	SA-SI
*F. cretica*L	Per	Ch	ME
Zygophyllum aegyptium Hosny	Per.	Ch	ME
Z. coccineum L.	Per.	Ch	SA-SI+S-Z
Z. decumbens Delile	Per.	Ch	SA-SI
Z. simplex L.	Ann.	Th	PAL

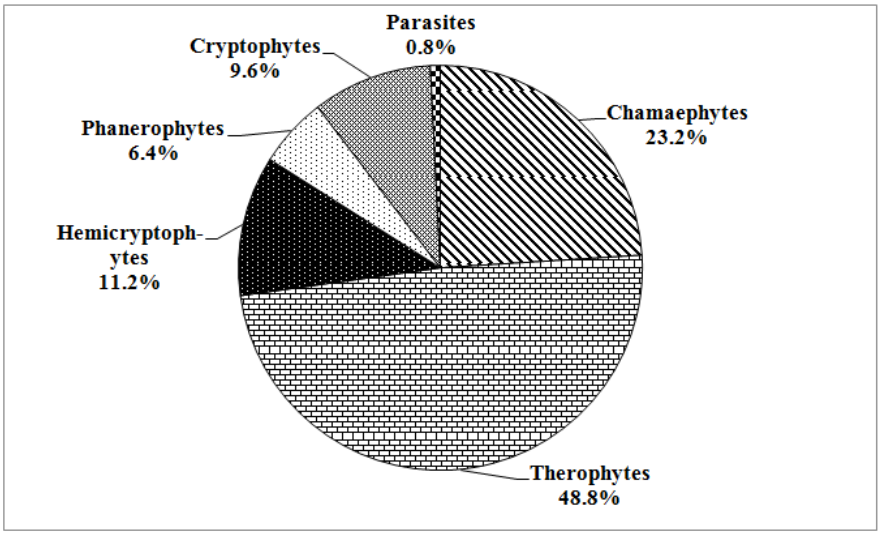

Figure 2. Life-form spectrum of the recorded plant species in the study area

Table 2. Number of species and percentage of the floristic elements in the present study

Floristic region	Number	%
Mono-regional		
ME	13	10.4
SA-SI	24	19.2
Total	37	29.6
Bi-regional		
ME+IR-TR	7	5.6
ME+SA-SI	17	13.6
ME+ER-SR	4	3.2
SA-SI+S-Z	9	7.2
SA-SI+IR-TR	9	7.2
S-Z+IR-TR	1	0.8
Total	49	39.2
Pluri-regional		
COSM	10	8
PAN	1	0.8
PAL	3	2.4
NEO	1	0.8
AUST	1	0.8
ME+PAL	2	1.6
ME+IR-TR+ER-SR	10	8
ME+ SA-SI+ IR-TR	6	4.8
ME+SA-SI+ER-SR	2	1.6
ME+SA-SI+S-Z	2	1.6
Total	38	30.4

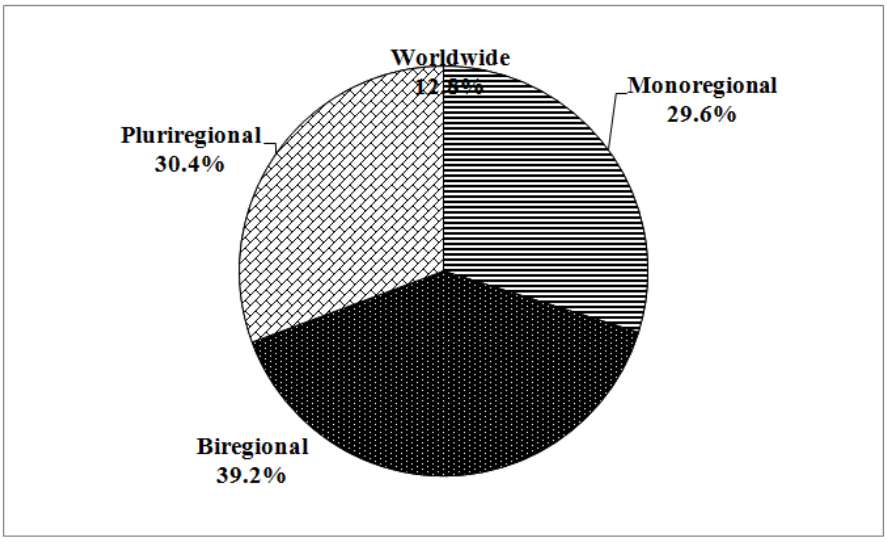

Figure 3. Floristic category spectrum of the recorded species

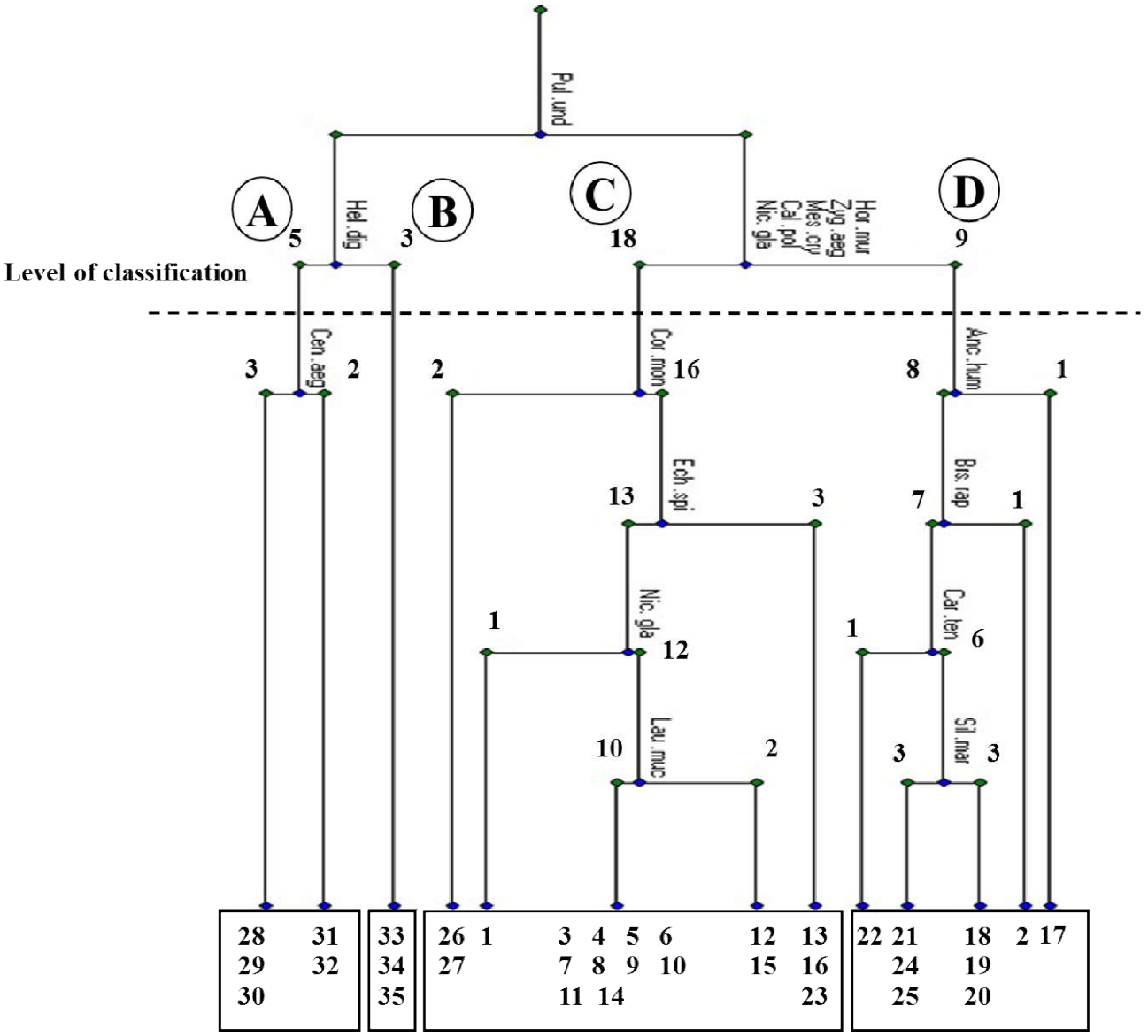

Figure 4. Two Way Indicator Species Analysis (TWINSPAN) dendrogram of the 35 sampled stands. Indicator species were abbreviated by the first three letters of genus and species, respectively. Dashed line represents the 3rd level of classification. Vegetation groups are coded A, B, C and D

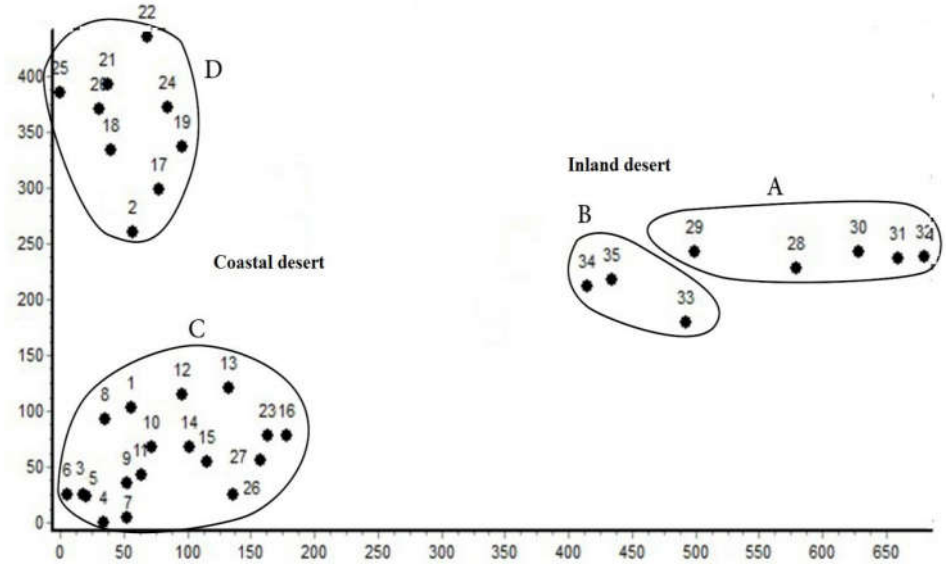

Figure 5. DCA-diagram showing the distribution of the four TWINSPAN vegetation groups

Quantitative vegetation analysis

The application of TWINSPAN for the 35 sampled stands produced four vegetation groups (labeled A, B, C and D) at the 3rd level of classification (Fig. 4). These groups were named after the first dominant species that attained the highest importance value (IV). Group A: *Zygophyllum coccineum* (IV=28.5), group B: *Pulicaria undulata* (IV=64.3), group C: *Calligonum polygonoides* (IV=40.7) and group D: *Nicotiana glauca* (IV=44.8). *Z. coccineum* community includes 34 species distributed in 5 stands, and it represents the wadi-bed habitat of Wadi Hagul in the inland desert of the North Eastern Desert. The most important associates in this community includes *Iphiona mucronata* (IV=19.5), *Lavandula coronopifolia* (IV=18.8), *Zilla spinosa* (IV=15.9), *Ochradenus baccatus* (IV=14.6) and *Pulicaria undulata* (IV=11.6). *Pulicaria undulata* community comprises 3 stands with 19 species and it occupies the wadi-bed habitat of Wadi El-Molak in the inland desert of North Eastern Desert. *Zygophyllum simplex*, *Achillea fragrantissima*, *Cynodon dactylon* and *Heliotropium digynum* were represented the important associates in this community with IVs 21.2, 15.4, 12.8 and 12.3, respectively. On the other hand, *Calligonum polygonoides* community comprises 69 species in 18 stands and *Rumex pictus* (IV=17.7), *Zygophyllum aegyptium* (IV=17.4), *Senecio glaucus* (IV=11.1) and *Cakile maritima* (IV=9.5) were the important associates. This community inhabits the roadside and sand formation habitats along the coastal desert of Deltaic Mediterranean Sea. Fifty-nine species distributed within 9 stands were represented the *Nicotiana glauca* community and occur in the roadside of the coastal desert of Mediterranean Sea. The most important associated species in this community includes *Mesembryanthemum crystallinum* (IV=14.9), *Hordeum murinum* (IV=11.3), *Silybum marianum* (IV=8.5) and *Juncus acutus* (IV=7.5). Moreover, the two species namely, *Imperata cylindrica* and *Tamarix nilotica* were recorded in all communities.

DISCUSSION

Recently, the basic objective of ecologist to document the distribution of plant species especially medicinal, rare, endemic and threatened ones in their natural habitats (Motzkin *et al*., 2002). Collectively, one hundred and twenty-five associated species were recorded with *Calligonum polygonoides*, *Nicotiana glauca*, *Pulicaria undulata* and *Hyoscyamous muticus* in the study area. The coastal desert of the Deltaic Mediterranean Sea, where *C. polygonoides* and *N. glauca* were collected constituted 95 species whereas; inland desert where, *P. undulata* and *H. muticus* inhabited hosts 44 species. Therefore, the coastal desert was more diverse than inland desert. This may be attributed to the heavy rainfall in coastal desert that give a good opportunity for several species to appear (Zahran and Willis, 2009; Shaltout *et al*., 2010). Asteraceae, Poaceae, Chenopodiaceae and Brassicaceae were the leading families represented collectively by about 55.2% of the total number of recorded species. Boulos (2009) reported that, these families together accounted for 34% of the Egyptian flora. Regarding species/genera proportion, the average global proportion is 13.6 whereas in the Egyptian flora is 2.9 (Boulos, 2009) compared to 1.2% in the present study. Therefore, the study area is relatively more diverse in genera than other region with the same number of species.

Preponderance of perennials, therophytes and Saharo-Sindian/ Mediterranean taxa was noticeable in the present study. This finding reflects the hot-arid climate, topographic variation and biotic factors in the study area (Heneidy and Bidak, 2001). The domination of therophytes was corresponded to the Mediterranean climate as well as due to their short life cycle, high reproductive capacity and ecological and genetic plasticity (Mashaly *et al*., 2015). These results coincided with the previous studies of El-Halawany *et al*. (2010), Abd El-Aal *et al*. (2015) and Mashaly *et al*. (2015). The present study comprises a mixture of floristic categories such as Mediterranean, Saharo-Sindian, Sudano-Zambezian, Irano-Turanian, Euro-Siberian, Cosmopolitans, Palaeotropical and Neotropical elements with variable number of species. This finding assures the capability of certain floristic elements to penetrate the study area from other neighboring phytogeographic regions (Seif El-Nasr and Bidak, 2006; Shaltout *et al*., 2015)

Four vegetation groups were yielded using TWINSPAN cluster analysis. These groups were named after the first dominant species. Group A: *Z. coccineum*, group B: *P. undulata*, group C: *C. polygonoides* and group D: *N. glauca*. *Z. coccineum* community represents the wadi-bed habitat of Wadi Hagul in the inland desert of the Eastern Desert. *P. undulata* community occupies the wadi-bed habitat of Wadi El-Molak in the inland desert of North Eastern Desert. On the other hand, *C. polygonoides* community inhabits the roadside and sand formation habitats along the coastal desert of the Deltaic Mediterranean Sea. *N. glauca* community occurs in the roadside of the coastal desert of the Deltaic Mediterranean Sea. Further, these communities were apparently segregated along DCA-axes. These results were in agreement with the studies of Mashaly (1996, 2001) and Mashaly *et al*. (2015). In conclusion, due to the recent human-induced threats that affect vegetation composition and disturb plant communities, numerous wild plants especially medicinal are becoming threatened. So, a conservation strategy for the medicinal plants is being urgent and required.

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